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The Idea of the Region

Herbertson Memorial Lecture

E. W. GILBERT

FIRST LET ME SAY how much I appreciate the honour of the Executive Committee's invitation to give the Herbertson Memorial Lecture. Andrew John Herbertson died in 1915. The Geographical Association's memorial to him, organized during the first world-war, was the establishment of a named lecture; the first of these Memorial Lectures was delivered in 1918. This lecture is only the thirteenth in the series, as the lectures have been given about once in every three years, and there was a long interval without a lecture during the last war. The original wish of the founders was that as many as possible of the lecturers should have been Herbertson's old pupils at Oxford or have been associated with him in some way. The progress of time eventually makes it impossible to fulfil an intention of this kind. Neither Professor Stamp, who gave the last lecture at Matlock in 1957, nor I ever met Herbertson, but I believe that all the previous lecturers must have done so.[1]

It is sometimes forgotten that Herbertson died before he reached the age of 50. In his comparatively short life he gave immense service to the cause of geographical teaching in this country and especially to the Geographical Association; for the last 15 years of his life he was its Honorary Secretary. He edited the Association's journal, then known as the *Geographical Teacher*, from its first issue in 1901 until his death. The main purpose of much of his work was to improve the standard of geographical teaching in British schools and he used his ideas on natural regions as a means to further that same end. In the last lecture in this series Professor Stamp discussed these ideas of Herbertson's and showed how well they had worn even after fifty years. My object today is rather different. I intend to speak on 'the idea of the region', not especially in relation to Herbertson, but in a more general context, and one that is not solely geographical.

The idea of the region is a difficult and complicated theme. It is perhaps appropriate that an Oxford geographer should speak to you on this particular topic. For it was in Oxford, in the early years of this century, that first Mackinder and then Herbertson developed their geographical ideas about what they both called the *natural* region; ideas which have had such a powerful influence on the teaching of geography in both the schools and the universities of Great Britain. I must say at once that I regard regional geography as the very pith and

➤ Professor E. W. Gilbert delivered the Herbertson Memorial Lecture at the Annual Conference of the Association in the London School of Economics on 1st January, 1960. He is especially indebted to Professor W. H. Parker for his helpful comments on this paper.

core of our subject: that is my confession of faith. In this lecture I propose to relate regional geography, the study of regions by geographers, to English literature and also to politics. First I must make it abundantly clear that we geographers have no exclusive rights to the idea of the region. But surely the region is the field which we should be well qualified to cultivate. It is all the more regrettable to find that the place of regional geography as the citadel of our whole subject is not as strongly defended in these days as it once was.

Now, what is a 'region'? What does the word mean? The word is derived from the Latin *regio*, the straight line ruled by the augur's staff when he delimited the 'regions of the sky'. The augurs divided or 'ruled' the heavens before they gave their opinions or advice on coming events. At the end of this lecture I myself will take the auguries and thus see what I can prognosticate for the study of geography in Britain.

Herbertson said that "a natural region should have a certain unity of configuration, climate, and vegetation".[2] More recently it has been argued by many writers that "a region is an area of common living". Professor E. G. R. Taylor defined a region as "a unit area of the Earth's surface", distinguishable from a mere area by the exhibition of some unifying characteristic or property. She once remarked that planning regions "should possess intrinsic 'wholeness' " and "social unity".[3] From these few definitions it appears that the unifying factor which makes a mere *area* into a *region* may be a natural one, or it may have been impressed on the area by some form of human use. In either case the region is often so clearly distinguishable as a separate entity that it receives recognition in the shape of a distinct name. Take for example the Lake District, the Black Country, the Vale of the White Horse, the Paris Basin; or on a larger scale, the Alps, the Sahara.

Now geography is, in my view, the art of recognizing, describing and interpreting the personalities of regions. Regions, like individuals, have very different characters; moreover, the characters of regions, like those of individuals, are constantly changing or developing. The art of describing a region—and I do consider it to be an art, for it is futile to regard it as an exact science with universal laws—is quite as difficult as the art of describing the character of a human individual. One cannot appreciate human personality purely by a study of human anatomy and the chemistry of the body; so one cannot, as some geographers so vainly imagine, appreciate geographical individuality by a study of geological and climatic conditions alone.

My old friend Professor George Kimble, in his strangely illogical essay "The inadequacy of the regional concept",[4] has attacked the idea of the region "on the grounds that the notion is vague, that some of the definitions put forward are confused and pretentious, that regions do not exist in reality, cannot be directly perceived, have no constant characteristics or clear boundaries". That summary of Professor Kimble's views was made in 1958 by my Oxford colleague, Mr. A. F.

Martin, and he went on to speak of the essay in these words:—"it is a flogging of dead horses, carried out with a gaiety of wit, a zestful insouciance of language and a fine disregard of logic which make it both enthralling to read and fatally misleading to digest inwardly".[5] Professor Kimble wrote "that it is still uncertain whether we could contrive to establish regional geography on a rigorously scientific foundation"[6] and he imagined that by making that assertion he had discredited the whole idea of the region. I entirely agree that regional geography does not rest on a rigorously scientific foundation; but that fact (and there is no uncertainty about it in my mind, as there is in Professor Kimble's) does it no discredit whatsoever. Regional geography is an art comparable with other arts; both poetry and painting can and do portray landscape. Geographers possess no monopoly in the difficult task of describing landscape. If they are to make their regions vivid and alive, they should possess something of the expressive and sensuous imagination of poets and painters; they have all the riches of the English language at their disposal.

The whole idea of the region will gain in interest if you regard it as a tendency in European thought which has appeared in three entirely different forms in the years since 1800. First, there is the development of a new technique in the study and teaching of geography. The academic idea of the 'natural region' and later of the 'geographical region' has had a powerful influence on teaching. Second, the regional novel has become a marked feature of prose fiction in this and other countries. In England Thomas Hardy's delineation of Wessex, D. H. Lawrence's descriptions of Nottinghamshire and Mary Webb's accounts of parts of Shropshire are typical of the work of many other writers. Finally, there has been the rise of the political and social idea known as 'regionalism', which is primarily connected with government and politics.

These three activities—of academic geographers, of writers, poets and novelists, and of political thinkers and administrators—have been going on at roughly the same time. And they have enough characteristics in common to justify the belief that they bear some relation to each other.[7]

THE GEOGRAPHER'S IDEA OF THE REGION

It may surprise you that I do not propose to say a great deal about this aspect of the subject. This is not a lecture about Passarge, Hettner, Thornthwaite and the rest

> Maintaining, with no little heat,
> Their various opinions!

The rise of the regional idea in the study of geography must be well known to you already. Regional geography is now an essential part of your work; it is a means for the study of geographical material. I have mentioned the distinction between the 'natural' region on the one hand and the 'functional' region of common living on the other. The most recent developments of both ideas by various authors have been outlined with admirable clarity in a notable article by Mr. G. W. S. Robinson of the University of Southampton.[8]

Herbertson's famous paper on natural regions was read to the Royal Geographical Society on 29th February 1904. On that occasion he made a division of the world into its natural components; his map was an analysis of the whole world. An entirely different method is to build regions from the small to the large. The smallest areas are first distinguished and then grouped to form larger and larger divisions. In Britain this synthetic approach is chiefly associated with the name of Professor J. F. Unstead. I should remind you that he elaborated his ideas on this subject in the Herbertson Memorial Lecture for 1933;[9] he gave the name 'stow' to the smallest of his divisions. Unstead's theories are still held in great respect in Germany, where many geographers like Passarge have held similar opinions and have put them into practice more elaborately and with Teutonic zeal. In France the theory of regions has not given rise to world frameworks, but to the writing of many classic studies of the regions of France itself, following Vidal de la Blache's *Tableau de la Géographie de la France* (1903). The French ignored theories and produced the regional literature.

What are the present tendencies in geographical thought? First, there has been a steady turn of interest from the analytic to the synthetic method. This is very closely associated with detailed research in Germany. Recently 44 German academic geographers combined to produce a map of Germany divided into 460 minor units, which are grouped into 88 larger divisions.[10] In the second place it is now fully realized that there are very few 'natural' regions. Human occupation has transformed almost every region wholly or at least in part. Herbertson himself said that in some regions man is part of the whole, "having set his mark all over its surface" and "is an essential part of it".[11] The idea of human activity and its results is now part and parcel of the idea of a region. Many modern cities cover so great an extent of land that they form distinct regions by themselves; for example Greater London exceeds 720 square miles. Urban geography is thus a form of regional study. Every geographical aspect should be considered in a regional treatment of a town.[12]

Thirdly, as a result of work in many countries, in France,[13] Germany, the United States, and also in Britain there has arisen the study of the town in its region. It is now accepted that many towns have as their principal function the provision of urban facilities and amenities for the population of the surrounding rural areas. "Going into town" is part of the life of almost every countryman; hence the local metropolis and the region it serves by motor-bus, local newspaper, piped water, and by many other services, possesses a functional unity. The delimitation of these functional regions has become an important part of the geographer's work and can be of great practical value. Perhaps the urban 'fields' as they are called, on the analogy of the magnetic field, have more reality than the so-called 'natural' regions. Fig. 1 shows the area of 'community of interest' round the city of Cambridge; it is about 820 square miles in extent and contains a population of 300,000, that is more than three times the population of the city itself. The limits of the area linked to Cambridge were defined after a detailed survey of shopping, entertainment and professional services. A more rapid method of finding the approximate area looking to a town as its main centre is to use the one criterion of the circulation of a weekly newspaper. The area on Fig. 2 is based on the circulation of the *Cambridge Independent Press and Chronicle*. It is clear that the circulation area of this weekly newspaper roughly approximates to the area shown on Fig. 1. The circulation area of the *Oxford Times* is marked on Fig. 3 and is a rough guide to the area which looks to Oxford as its main centre. It will be noticed that a considerable part of north Berkshire as well as parts of Oxfordshire are inside the city's sphere of influence. The *Oxford Times* circulation area is about 850 square miles in extent and holds a population of 350,000. The areas which are linked with the two university cities are thus curiously similar in both extent and population.[14]

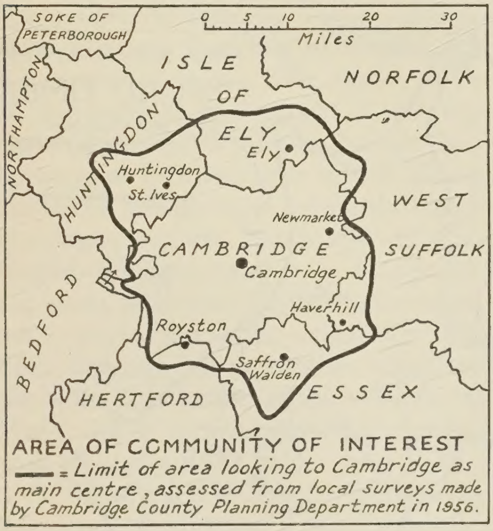

Fig. 1.

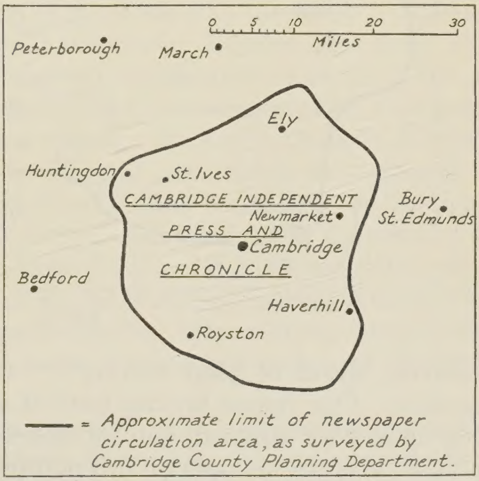
0 5 10 20 30
Miles
Peterborough
March
Ely
Huntingdon
St. Ives
CAMBRIDGE INDEPENDENT PRESS AND CHRONICLE
Newmarket
Bury St. Edmunds
Cambridge
Bedford
Haverhill
Royston
= Approximate limit of newspaper circulation area, as surveyed by Cambridge County Planning Department.

Fig. 2.

On the whole it is true to say that the views of British geographers have had little influence on public opinion and political affairs. This is partly because so much geography is written in such poor English. Our work is often so shoddy in craftsmanship that it is quite unreadable: we lack a proper feeling for words. As Professor O. H. K. Spate said in his inaugural lecture at Canberra in 1953, "some geographers seem positively afraid of good writing".[15] Geography is seldom popular literature. One reason for this state of affairs is that so many English geographers are obsessed with the belief that regional geography is an exact science. In my opinion it is nothing of the kind; it is the humane and subjective art of describing regions, and until it develops some literary graces it will not be read by many besides professional geographers. Dr. G. M. Trevelyan has pointed out that "in our day not a few historians are writing readable history, which is no longer considered bad form, as it was at the beginning of this century, when the reaction against Macaulay was at its height."[16] Perhaps in due

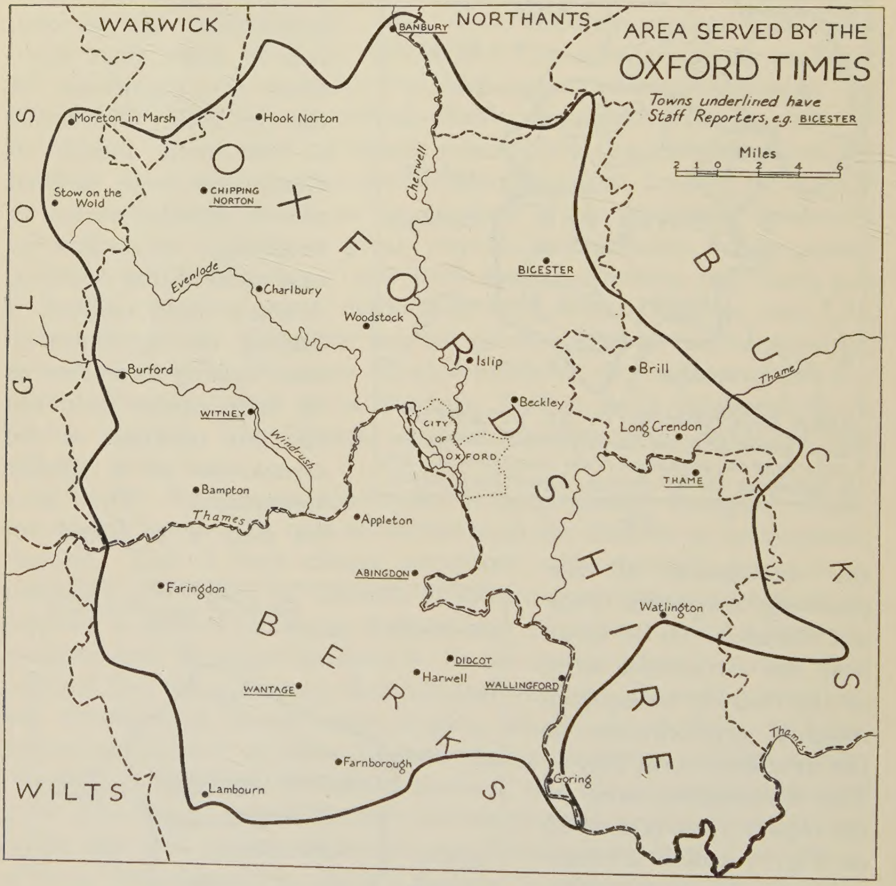

Fig. 3.

time there will be a reaction in geography also and it will become fashionable to make the subject readable once more. And so we turn, quite naturally, to consider how English novelists have made use of the idea of the region.

THE REGIONAL NOVEL

Fig. 4 is drawn, with the author's kind permission, from a map by Lucien Leclaire, now Professor of English Language and Literature in the University of Caen. The names of the novelists were placed, as far as was possible, on the part of the map which was the setting of their regional novels. Professor Leclaire's two interesting and remarkable books have received little notice in English geographical periodicals.[17] Leclaire's treatment is primarily historical and he divided his subject into three periods. From 1800 till about 1830 the forerunners of the English regional novel have a national rather than a regional flavour. But from 1830 until say 1870 the novel becomes more narrowly local, while during the eighty years after 1870 the regional novel proper has been developed in a number of different forms. The map brings out the wide distribution of the work of regional novelists in England and Wales but it is noticeable that more of them have written about the west than about the east.

In the opinion of Phyllis Bentley, the "four great writers of the past who created, developed, and possibly perfected the English regional novel"[18] are Charlotte Brontë, George Eliot, Thomas Hardy and Arnold Bennett. Charlotte Brontë's classic regional novel *Shirley* was published in 1849. The setting of this book is in the woollen district of the West Riding. Most of the characters in the book gain their livelihood from the textile industry which is intimately connected with the physical geography of the region. The conversation and dialogue in the book are often in regional speech. In Emily Brontë's *Wuthering Heights* (1847) the setting is regional and there are magnificent descriptions of the moors of the West Riding but the plot is not tied to place. Two of Mrs. Gaskell's novels about industrial Lancashire can be classed as regional: *Mary Barton* (1848) and *North and South* (1855). In both books dialect is freely used. *North and South* contrasts the peaceful life of a rural county in the south with the "almost brutal strenuousness of the manufacturing north" as the author had seen it in "Milton", that is Manchester.

Anthony Trollope was not a regional writer because his places were not real. He created a new county, Barsetshire, which looks very much like "a county in the west of England . . . its green pastures, its waving wheat, its deep and shady and—let us add—dirty lanes, its paths and stiles, its tawny-coloured, well-built rural churches, its avenues of beeches, and frequent Tudor mansions, its constant county hunt, its social graces, and the general air of clanship which pervades it, has made it to its own inhabitants a favoured land of Goshen".[19] In *The*

Warden (1855), the first of the Barchester series, he created the fictitious cathedral town of Barchester. "Were we to name Wells or Salisbury, Exeter, Hereford or Gloucester, it might be presumed that something personal was intended". It is possible to draw a map of Barsetshire, because Trollope's fictitious topography was consistent.[20] This convention was Trollope's idea and it was followed by George Eliot and Thomas Hardy. But these two authors described real places to which they gave different names.

George Eliot's first four novels are regional. *Scenes of Clerical Life*, first published in *Blackwood's Magazine* in 1857, describes the Warwickshire environment in which the author spent her early life. "Milby" is Nuneaton and was easily recognized as such by readers at the time of publication. The action in *Adam Bede* (1859) takes place in "Loamshire" (Staffordshire) and "Stonyshire" (Derbyshire). In *The Mill on the Floss* (1860) the original of "St. Oggs" is Gainsborough on the Trent, the town in which Sir Halford Mackinder was born on February 15th, 1861, only a few months after the appearance of the novel. Mackinder often used to refer to George Eliot's connection with his birthplace, and to the eagre or "crest-fronted wave" coming up the Floss. In *Silas Marner: The Weaver of Raveloe* (1861) the setting is in Warwickshire once more, "Raveloe" being Bulkington, near Nuneaton.

The region of George Eliot is largely agricultural, as is the Wessex of Thomas Hardy. The fourteen novels by Hardy, as well as some volumes of short stories, were published between 1871 and 1896. All these books have their setting in Wessex, the six counties in the south-west of England. Hardy says "that the area of a single county did not afford a canvas large enough" for his purpose; nevertheless, his Dorset is an individuality. Hardy portrays every aspect of this lovely landscape. His detailed observation of the scene is matched by his knowledge of the history and traditions of the region. In a valuable paper, by means of skilfully chosen quotations from Hardy, Professor H. C. Darby has described the five divisions of Dorset as they appear in the novels:—the chalk upland, the vale of Blackmoor, the heathlands and heathland valleys, the Isle of Purbeck, and western Dorset.[21] Hardy devised new place-names for the whole of the large area of Wessex; in the later editions of his novels a map with these names is included. The community described by Hardy was almost entirely agricultural and lived mainly in villages. It must be remembered that the Wessex of Hardy's novels is a landscape of the nineteenth century, and that it has been greatly changed in the last hundred years. It is satisfactory to record that, in August 1959, the so-called Hardy country, an area of about 400 square miles in Dorset, was designated as an "area of outstanding natural beauty" by the Minister of Housing and Local Government, and came under the authority of the National Parks Commission.

Arnold Bennett's novels deal with an urban region, the industrial area of the Potteries which he made known as the Five Towns. His five, Turnhill, Bursley, Knype-on-Trent, Hanbridge and Longshaw are easily identified as Tunstall, Burslem, Stoke-upon-Trent, Hanley and Longton. Fenton never forgave Bennett for omitting it. Bennett began his series with *Anna of the Five Towns* (1902) in which the scene is laid mainly in Burslem. The Five Towns are, in Bennett's words, "mean and forbidding of aspect—sombre, hard-featured, uncouth", but just as Hardy had described ploughland and heath, so Bennett writes, with equal affection, of pot-banks and furnaces. "Bursley", said Bennett, "lies toward the north end of an extensive valley, which must have been one of the fairest spots in Alfred's England, but which

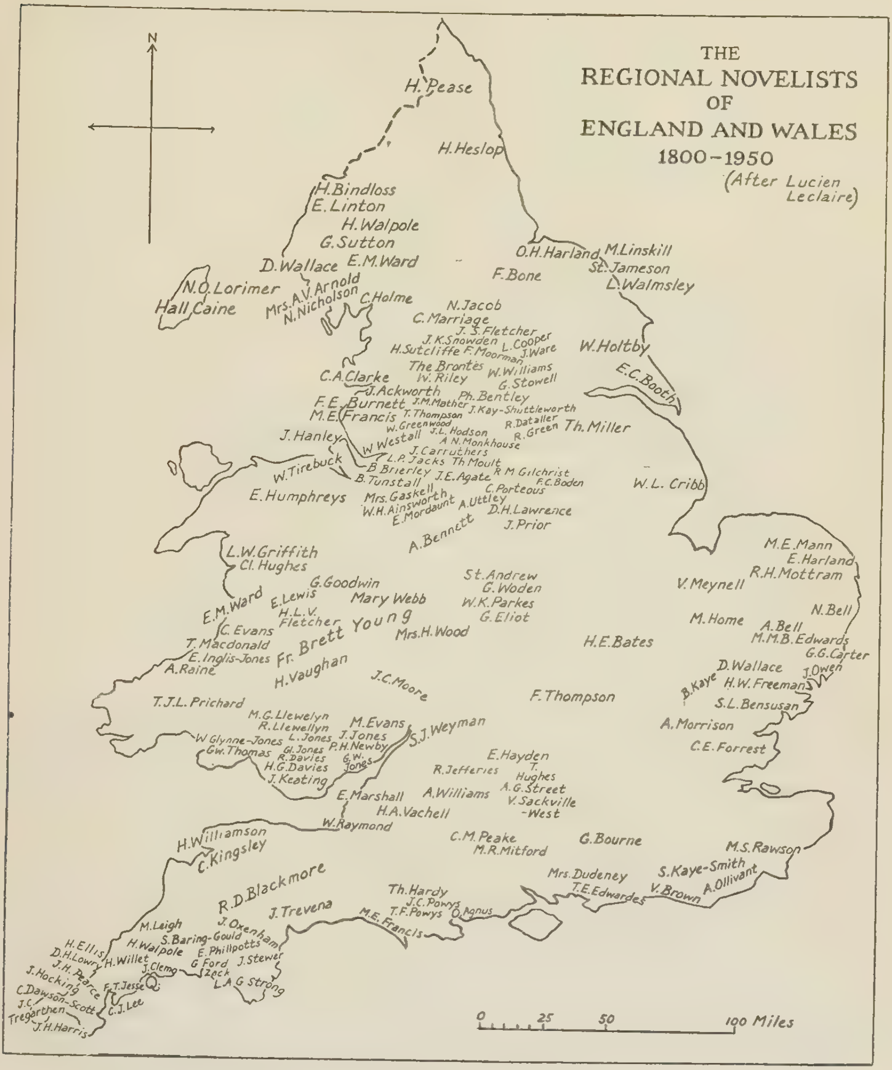

Fig. 4.

is now defaced by the activities of a quarter of a million people . . . Nothing could be more prosaic than the huddled red-brown streets; nothing more seemingly remote from romance. Yet be it said that romance is even here . . . Look down into the valley . . . embrace the whole smoke-girt amphitheatre in a glance, and it may be that you will suddenly comprehend the secret and superb significance of the vast Doing which goes forward below. Because they seldom think, the townsmen take shame when indicted for having disfigured half a county in order to live. They have not understood that this disfigurement is merely an episode in the unending warfare of man and nature and calls for no contrition".

The single industry of the Potteries made this region into an industrial and social unit. In a passage in *Whom God Hath Joined* (1906) Bennett brings out this unity:—"All around the horizon . . . the yellow fires of furnaces grow brighter in the first oncoming of the dusk. The immense congeries of streets and squares, of little houses and great halls and manufactories, of church spires, and proud smoking chimneys and chapel towers, mingle together into one wondrous organism that stretches and rolls unevenly away for miles in the grimy mists of its own endless panting". The nineteenth century industrial community is the theme of Bennett's work—the Five Towns with "all their vast apparatus of mayors and aldermen and chains of office, their gas and their electricity, their swift transport, their daily paper, their religions, their fierce pleasures, their vices, their passionate sports and their secret ideals . . .". Bennett's graphic account of the "wondrous organism" of the conurbation is an aid to geographical understanding.

Another industrial area, the Nottinghamshire coalfield, is the setting of much of the work of D. H. Lawrence; for example his *Sons and Lovers* (1913).[22] E. C. Booth described the Holderness district of Yorkshire and Hull with fidelity and considerable use of dialect; his *Cliff End* (1908) has been compared with George Eliot's work. Another novelist of the rural scene is Mary Webb, who writes of Shropshire, a region lying between "the dimpled lands of England and the gaunt purpled steeps of Wales". In *Precious Bane* (1924) Mary Webb displays her close knowledge of life on the Welsh border. Phyllis E. Bentley's novels give a vivid picture of the West Riding and its grim beauty; her *Inheritance* (1932) is especially notable for its fidelity to place. Then there is Winifred Holtby's classic *South Riding: An English Landscape* (1936). Writing of Robert Carne, the farmer hero of the book, she says: "He worshipped the creator of earth and heaven, the Lord of Harvest, the Ancient of Days and Seasons, who had in his beneficent providence ordained that Yorkshire shall be the greatest county in England, which was the grandest country in the world, the motherland of the widest Empire, the undoubted moral leader of civilisation, the mistress of the globe". Carne must have been taught geography by Unstead's synthetic method of building up from small to large!

English regional novelists display many merits that geographers can recognize and envy. The novel has illuminated the English landscape more brilliantly than any other art. Again many novels present life and work on a clearly marked piece of land with truth. Reality is faithfully shown: it is not lost in the dim twilight of modern geographical jargon. The novelists paint a picture of real earth with the fine attention to detail of a Dutch work of art. "The regional novel", said Phyllis Bentley, "has a particular strength in the depiction of character, for the two great factors in the formation of character are heredity and environment, and in the regional novel characters are shown in their native environment, and surrounded by their families, i.e. their ancestors and their descendants".[23]

The task of the regional geographer can resemble in some respects that of the regional novelist. The regional geographer strives to integrate the multitude of seemingly disconnected facts about nature and man in the region he is describing. "Geography", said Mackinder, "presents regions to be philosophically viewed in all their aspects interlocked".[24] Geographers must have a sound understanding of the physical geography of the region they are studying, its land forms, its climate, its vegetation; but they should also be aware of man's place in the whole environment. It is essential that they should not devote their attention to one factor only. It would be a misfortune if the specialists were to gain complete control of British geography. The regional geographer can be regarded as the modern successor of the ancient Greeks. "A sense of the wholeness of things is perhaps the most typical feature of the Greek mind", said Professor Kitto, and added, "the modern mind divides, specializes, thinks in categories; the Greek instinct was the opposite, to take the widest view, to see things as an organic whole."[25] Modern geographers can make plain the truth that knowledge is one and indivisible. To split learning into subjects, and especially into Arts and Science, is entirely arbitrary, a mere convenience for time-tables and examinations. Nobody can be omniscient; no one person can deal with the whole universe, but that need not prevent attempts to break down barriers between subjects.

Like the Greeks the modern regional geographer tries to see things as a whole. He often fails to achieve this aim and he is bound to envy the greater success of the regional novelist. The intense power of environment in men's lives has been clearly perceived by many writers who are not geographers. Somerset Maugham in his *Razor's Edge* (1944) said: "Men and women are not only themselves; they are also the region in which they were born". This can be matched by Edmund Blunden's words "we have lived this landscape" in his poem "At Rugmer". But especially towards the end of his life Herbertson also saw the region as an active force. In a remarkable lecture entitled "Regional Environment, Heredity and Consciousness", published after his death, he wrote: a region "is not merely a passive environment, a theatre of human action of which we must know the stage properties. It is something alive, active, not merely letting man act on it, but vigorously reacting on man. No one who has read any description of the retreat from Moscow can ever think of environment as passive, but neither can anyone who has understood the huertas of Spain or the terraced vineyards of the Rhine".[26]

The regional element in English literature has been strong, but it has been equally strong in the literature of other European countries.[27] In the United States the wheat, maize and cotton belts have each received their regional portraits. The American contribution to this class of writing has been closely concerned with short stories; there has been an astonishing outburst of writing of this kind since about 1870. Dr. Robert L. Ramsay compiled a map of the five major and twenty-five minor "Local Color Regions" of the U.S.A.[28], which is based on the writing of short stories.

The regional novelists have been able to produce a synthesis, "a living picture of the unity of place and people", which so often eludes geographical writing. The geographer often speaks of the "personality" of a region and this is exactly what the novelist has brought out so strongly. He has been able to reveal the individuality of a particular landscape. All this lends support to the conclusion that regional description can never be an exact science, in spite of its scientific appearance; and that it will achieve greater success by the use of artistic and subjective methods. The view that "a science of regions is a vain dream" has been held by Professor John Leighley. He argued that "literary art, not systematic description, is the proper medium of regional synthesis".[29] More recently, Professor Max Sorre, while deploring recent post-war tendencies in French geographical thought, concluded that the unity of the geographical complex should not be broken in regional description. He went on to say: "Le complexe physionomique doit toujours rester présent dans son intégralité. Et c'est pourquoi ensuite il n'est pas de vrai géographe sans des parties d'artiste. Dira-t-on qu'en demandant au géographe d'avoir des yeux pour voir, un nez pour sentir, des oreilles pour entendre, de traduire ses sensations d'une manière précise, colorée et vivante, nous réintroduisons ce qu'il y a de plus individuel, de plus subjectif, de moins scientifique, le talent? Et après? Depuis quelques décennies, la méfiance à l'égard de l'expression littéraire s'est étendue. Notre discipline en est appauvrie . . . N'allons pas croire que l'absence de style soit d'obligation pour le géographe d'aujourd'hui".[30] A great master of geography has described the way in which mere area acquires geographic individuality. These are the words of Vidal de la Blache: "A geographical individuality does not result simply from geological and climatic conditions. It is not something delivered complete from the hand of Nature . . . It is man who reveals a country's individuality by moulding it to his own use. He establishes a connection between unrelated features, substituting for the random effects of local circumstances a systematic co-operation of forces. Only then does a country acquire a specific character differentiating it from others, till at length it becomes, as it were, a medal struck in the likeness of a people".[31] It is because the regional novelists, by subjective methods, have so successfully made their regions like medals "struck in the likeness of a people", that I urge you to read and re-read their books. If a geographer reads Hardy and Bennett, he is not wasting his time.

THE POLITICAL IDEA OF THE REGION

The word 'regionalism' first appeared in 1874 and since about 1890 it has been in common use. It conveys the idea of political organization on a regional basis, but it can be applied equally well to economic and social affairs. Regionalism has grown in many countries as a movement against centralized government as well as against the influence of the capital in the modern state. It is impossible to deal adequately here with this large subject and I will only make a few comments about regionalism in England and Wales. But it should be remembered that regionalism has had greater force and vitality in Spain and France where it has sometimes developed into a struggle for the complete autonomy of a region.

England and Wales are divided into 52 ancient counties, the so-called geographical counties.[32] But for the purposes of administration they are divided into 62 Counties and 83 County Boroughs, that is towns with the status of a county. Although local patriotism, the salt and savour of English life, is closely linked with the ancient counties, they are not the actual units of administration. It is the belief of many people that the present administrative system, particularly the rigid division into Counties and County Boroughs, is out of date. It is often argued that new administrative areas, combining town and country, should replace the existing divisions and that such areas would be more consonant with the geography of the present day. Should these regions be essentially heterogeneous or homogeneous units? The large conurbations are homogeneous with a common interest in urban life and industry. By contrast, Herefordshire with a "balance of rural areas around a central county town . . . is an essentially heterogeneous unit, in the character of its different lands".[33] Professor Stamp is always very careful to make this fundamental distinction clear.

Geographers have often drawn up theoretical schemes for new regional divisions of England and Wales for the purpose of local government. Professor C. B. Fawcett was a pioneer in this respect.[34] In practice English governments have long used such regional divisions for military purposes. In 1803 England and Wales were divided into twelve military districts. An invasion by the forces of Napoleon was awaited and a regional organization was adopted to meet the emergency.

Again in 1939, before the outbreak of war, England and Wales were divided into eleven Civil Defence Regions, which functioned throughout the war. Since 1945 various government departments have used large regional areas for a variety of purposes instead of counties.

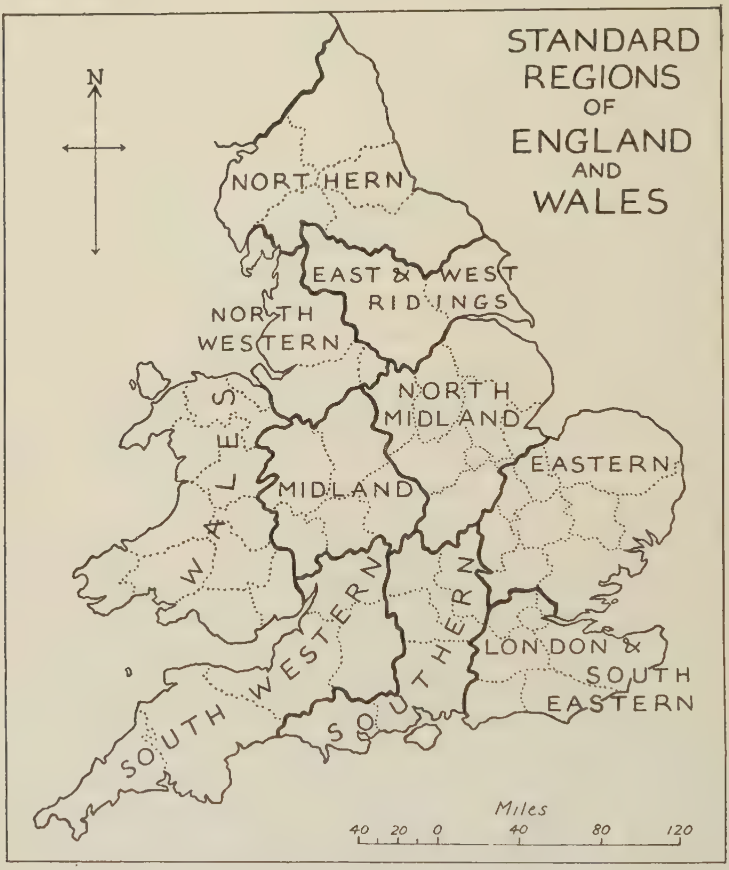

Fig. 5.

Nationalization has brought many new regional patterns; regional organization has been adopted for several public services, including electricity, gas and hospitals. In 1946 the Treasury adopted as "Standard" certain regions which closely corresponded to the Civil Defence Regions. The "Standard" regions are now firmly established and are used by ministries for a variety of purposes including statistics (Fig. 5). But they are not entirely satisfactory areas from the point of view of the geographer.[35]

The "Standard" administrative regions of England and Wales are based on large cities, and they have little connection with the older system of organization by counties. Britain is not the only European country which has had to face such problems. In Portugal, for example, there have been recent reforms in the administrative map with the object of making it more consonant with the geographical realities of today.[36] But the same questions have also appeared in larger states of continental dimensions like the United States of America or Australia. As the United States is of the same order of size as the whole continent of Europe, its 'regions', or 'sections' as they are sometimes called, like New England and the South, are comparable with France or Spain in magnitude, but the problem remains the same.

The idea of the region is not only a means for the theoretical arguments of geographers, and a tool for novelists and poets; it also has great practical value for the man of affairs. In preparing the way for the construction of regional areas which accord more closely with population units than the existing political divisions, geographers are performing an invaluable task. The practical importance of regional geography has been emphasized recently by a group of geographers in the U.S.S.R. As recently as 1958 a new geographical periodical was launched in the Soviet Union with the title *Geography and Economy*. This periodical was issued from Moscow University and enunciated two main themes in its statement of policy: (1) the necessity for effective integration between physical and economic geography and for the recognition of their philosophical unity; (2) the need to increase the practical relevance of geographical research to the development of the economy. The editors protested against the "discrediting" (so called) of geography in the latest edition of the *U.S.S.R.* volume of the *Great Soviet Encyclopaedia*, in which it is passed off as just physical geography. The editors conclude that "the greatest task of geographical science in the present stage of its development" is the "whole" study of regions, leading to their economic appraisal, and finally to suggestions for their rational use.[37] What is sometimes called in this country the Oxford view of the region, is certainly not a lost cause in the U.S.S.R.

CONCLUSION

Now I will take the auguries, as I promised at the beginning of this lecture. What future do I see for British Geography? First, as regards its place in the universities: here I see two tendencies which ultimately could do the subject great damage. I shall call these narrow specialization on the one hand, and rigid professionalism on the other. Take the first. The whole of our culture is beset by the many and great dangers of specialization; geography is not the only branch of learning in which we know more and more about less and less. There are in this country schools of geographical thought, each of which bears the outward signs of an esoteric cult. The initiates pursue recondite forms of intellectual activity which are only understood by themselves and their inner circle of disciples. I know full well that the pursuit of pure scholarship in the different branches of geography is essential, but it is perilous to allow the subject as a whole to drift progressively farther and farther away from lay comprehension. There is also a risk that, if geography becomes more specialized, it will break up into fragments which will be absorbed by other disciplines, some by geology, others by history, others by economics. The binding force which can keep this centrifugal tendency in check is regional geography; it must be strengthened. I have recently enjoyed the privilege of visiting ten university departments of geography in Germany and Austria. In each department I found teachers who were experts in one or more specialisms, often very abstruse in character; but each of them was also a master of every aspect of the geography of some region. German-speaking geographers have put into practice Hettner's precepts that those who do "not cultivate regional geography run the risk of leaving the ground of geography entirely. He who does not understand regional geography is no true geographer".[38]

Second, professionalism. I am much concerned by the tendency for geography to become too much of a profession. Geographers so often have no other aim than to teach the teachers of geography how to teach their successors. The training of teachers is very important work but it should not be regarded as our only task. If imaginatively taught, university geography can provide the same kind of liberal education as that given by the Classics—a training for life. Geography can be the right background for the holder of any position, however responsible, because it gives mental foundations for judgement in action. Personally, I regard geography as one of the humanities. In my view, it should be our object, not to produce more geographers as such, but rather "a succession of persons" of intellectual integrity, trained to reason and reflect on the conditions of mankind in relation to environment, capable of assessing human situations, "duly qualified for the service of God in church and state". We can achieve that purpose by providing our pupils with an integrated study of the environment of modern society—of the regions of the earth as the different scenes in the theatre of human life.

Next let me take the auguries for the schools. Fifty years ago, Herbertson was showing British teachers of geography that the idea of the region was absolutely necessary for their work, and I claim that this is still true. Upon you, the teachers of geography in the schools of this country, primary as well as secondary, preparatory as well as public, is laid an even heavier responsibility than in Herbertson's time. It is far greater on you in the schools than on those who teach geography in the universities, for the whole nation passes through your hands. There is now much argument as to what are the proper bases of school education. I believe that geography, the study of "the compass of the world and they that dwell therein", is an essential foundation of all such education. Geographical knowledge is needed for the proper understanding of so many other parts of the school curriculum. Without it much of human history is quite unintelligible; without it those branches of science that used to be called "natural history" cannot be fully appreciated. Again, a knowledge of the environment of the region we call Mediterranean Lands can re-vitalize the reading of the Bible and illuminate religious teaching. Further, there are many links between regional geography on the one hand, and English prose, poetry and art on the other. I have tried to show some of them in my lecture; you will find plenty more in that fine anthology, *Splendour of Earth* (1954), compiled by the late Mrs. Margaret Anderson of Girton College, Cambridge. Nevertheless, I am certain that you will not gain this pivotal position in school education, unless you integrate your teaching on the idea of the region.

Now I must conclude. I expect most of you make detailed investigations of small pieces of country. Where do these admirable local studies of small areas lead? They lead to larger and larger regions: from stows to tracts, and then to sections and provinces—if you adopt Unstead's terminology—and so to whole political states; and then to a federation of Europe's regions as one continent; and so to a union of continents—to the United Nations—to the whole world.

During the war, for a variety of reasons, those of us who remained in Britain, and especially those of us who were geographers, became increasingly aware that we were Europeans as well as British, that we had more than two thousand years of common European culture behind us. We knew, in 1940, that we were the last bastion of that great heritage. It was an exhilarating experience which we can never forget. At the present time it is especially urgent to revive the feeling that we are Europeans.

On the other hand, we knew, long before the war, and we are still aware now, that as British, we are citizens of a world Commonwealth. At the same time, we are provincially Yorkshiremen, Cornish or Londoners, while remaining nationally English. We geographers also know, and we can re-learn this from Mackinder, that "there is no complete geographical region either less than or greater than the whole of the earth's surface".[39] We are citizens of the World. In this air and atomic age the world is indeed one. The full and complete realization of this fact of unity is vital for us all.

Mackinder, in one of his most eloquent passages, wrote: "Neighbourliness or fraternal duty to those who are our fellow-dwellers, is the only sure foundation of a happy citizenship. Its consequences extend upward from the city through the province to the nation, and to the world. It is the cure alike of war between classes and war between nations".[40] In these words we can see the academic mission of the geographer.

I want to end this lecture on the idea of the region by emphasizing the note of diversity in unity. I think it is the right note to strike in a Herbertson Memorial Lecture. There is a diversity of regions as well as of human beings in one world—and regions as well as people are dependent on each other. The motive of geography is at bottom poetic. We geographers see the different regions as the separate limbs of one world. We know that, like every human individual, every region —however small—is a precious part of a whole.

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[2] A. J. Herbertson, "The major natural regions", *Geographical Journal*, vol. xxv, 1905, p. 309.

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[5] The words are quoted, with kind permission of the author, from A. F. Martin's unpublished contribution to a discussion on "Whither regional geography?" at the Annual Conference of the Institute of British Geographers at Nottingham on 5th January, 1958.

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[16] G. M. Trevelyan, "Greatness of Macaulay", *The Times*, 28th December, 1959.

[17] Lucien Leclaire, *Le Roman Régionaliste dans les Iles Britanniques* 1800–1950, Clermont-Ferrand, 1954; and *A General Analytical Bibliography of the Regional Novelists of the British Isles* 1800–1950, Paris, 1954. Fig. 4 is redrawn from the frontispiece of the latter volume. Professor Leclaire also compiled two maps (*Le Roman Régionaliste*, pp. 236–7) on which are underlined the names of regional novelists in whose books an industrial rather than a rural background is dominant. Professor Leclaire argued that between 1870 and 1910 by far the main interest of the novelists lay in rural regions but that from 1910 the pendulum swung in the other direction; and that between 1940 and 1950 novels with an industrial background were as numerous as those with a rural scene. It is worth noticing that as early as 1910, H. R. Mill's *Guide to Geographical Books and Appliances*, published for the Geographical Association, contained a chapter on geographical novels (pp. 58–63). In 1920 the Leeds Branch of the Geographical Association published *Short List of Novels and Literary Works of Geographic Interest.*

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[38] This is Richard Hartshorne's translation of "Der Geograph, der die Länderkunde nicht pflegt, läuft immer Gefahr, den Boden der Geographie überhaupt zu verlassen. Wer sie nicht versteht, ist kein echter Geograph". (Alfred Hettner, "Die Einheit der Geographie in Wissenschaft und Unterricht", *Geogr. Abende*, im Zentralinst. für Erzhg. und Unterr., Heft I, Berlin, 1919, p. 23, and Richard Hartshorne, "The Nature of Geography", *Ann. Assoc. Amer. Geogr.*, vol. xxix, 1939, pp. 634–5 [458–9].)

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Langstone Rock

An Experiment in the Art of Landscape Description

EWART JOHNS

THE ADVANCE OF GEOGRAPHICAL STUDIES on many fronts in the years since the second world war has brought the subject to a point where the reconsideration of its basic technique is essential, and indeed is widely performed. The performance, however, usually stops short at methodological debate, and while paying lip service to regional geography as an ultimate goal, few if any geographers practise it except in the form of lecture notes or text-books.

With historians already taking the initiative in a basic geographical field,[1] there is still a tendency for geographers to reject the challenge of the whole landscape.

Professor Balchin in his inaugural lecture at Swansea in 1955 said of regional geography: "Here we have a subject in which the approach is the reverse of specialization, synthesis instead of analysis, an art in place of a science . . ."[2] Though one would not wish to disagree with him that geography in its final form of expression is an art, indeed the view that it is a science is probably at the root of our difficulty; it is the assumption that this art is at the same time a synthesis that may have kept geography so long in a stranglehold of inactivity. Art does not necessarily involve synthesis. Art possesses qualities which synthesis alone cannot possess, because the aims of synthesis are governed by the need for completeness. Synthesis, as the Oxford Dictionary puts it, is "the building up of separate elements . . . in a connected whole". The free use of the word synthesis amongst geographers has too often been only a high-sounding way of describing the jigsaw puzzle technique of regional text-books. One of the most serious mistakes in the arguments of Mr. Tudor David "against geography",[3] is his assumption that synthesis is the aim of creative writing in geography or for that matter in any subject (though he is probably justified in believing that it is the view of many geographers themselves).

Art is very different from synthesis. It does not aim at completeness, or even have completeness as one of its essential components.[4] An unfinished work of art is not a contradiction in terms, but an unfinished synthesis is. Even if verbal logic cannot prove this to be true, Schubert and Leonardo da Vinci have already done so by example. What then distinguishes a work of art? A weighty question, but one

➤ Mr. Johns is a lecturer in geography in the University of Exeter. The Editor is indebted to the University of Exeter for a generous grant towards the cost of illustrating this article.

with which geographers must now grapple. Many books have been, and many more will be written on this subject; here it may suffice to say briefly how an understanding of the nature of art affects the geographer's position.

Like the research scientist the artist needs the freedom of experimentation. A set of rules of procedure is the first enemy of truly creative art. But like some original work in science also, art is concerned with the creation of new relationships[5] as well as with the analysis of existing, if hitherto unsuspected ones in nature. Indeed in some arts like music nature cannot be appealed to at all for inspiration or arbitration.

This search for relationships in art is guided by the need for ultimate formal balance, whether of sound, shape, mass, line, rhythm or colour, a balance which will convey the greatest meaning if the variations on the major themes reconcile the apparent contradiction of the need for both inventiveness and consistency. Movements from some of the Beethoven string quartets are amongst the most distinguished examples in the history of art of this uniqueness of balance.

These aims of the artist are all achieved through some form of expression, visual, oral or linguistic, and it is to forms of expression that the geographer must now pay special regard if he is to merit the distinction of the company of the artists, for he must believe that the description of landscape can ultimately take its place with the historian's description of events in time as a genuinely great contribution to human understanding.

The subject of geographic art, which is surely an inspiration enough, is landscape. One suspects that most geographers embark on their life's work excited in the first instance by the visual impact of scenery, and the need is to explore the immense possibilities of giving expression to these experiences in literary form. Enough, and more than enough has been said and written elsewhere to justify this attempt at a new art. Here it is proposed to do so using a small fragment of the coastline of "red" Devon, but it should be understood that scale is not significant within certain very wide limits, and the example is chosen because it inspired the writer, as might equally a spatter of Cornish cottages, the white cadences of the Aletsch glacier, or the geometry of fields on the North China plain. In embarking very humbly on this project, one is gratified to note W. G. Hoskins' comment[6] on Wordsworth's *Guide Through the District of the Lakes*: " . . . poets make the best topographers".

LANGSTONE ROCK

The railway which runs from Exeter to Dawlish strikes the west side of the estuary of the Exe at Powderham and then runs directly south until it reaches the sea. There it turns southwestwards along the coast. The bend in the line here lies in a cutting and leaves a corner of land like a large stack lapped by tides and trains. (Figs. 1, 2, 3, and Plate I.) This corner is Langstone Rock. Its shape is heavy and block-like from the landward, but arched and catacombed from the seaward side. Seen from a distance the top is very flat, with a few half-dead elder bushes providing the only relief. The whole mass is like a hastily erected sandcastle with fresh crumbling sides but patted hard on top.

Early on a fine morning the eastern side of Langstone Rock is rusty in the sun. At midday the colours cool to light earthy reds, with a crimson gloom in the caves, and in the evening, which comes early on this east-facing coast, a purple shadow rises slowly to the grassy rim of the cliffs.

Once this rock was a true headland with the sea hard at work narrowing its neck. Above where the carriages now rattle by, the plough, the scythe and the sickle worked for centuries to the brink of sheer cliffs. Maps from before the railway[7] and those plotting its proposed course[8] show how the old fields of the mainland embraced the top of the present rock and today faint earth banks and ditches can be distinguished from the other minor irregularities of surface (such as the embryo blow-holes). The striking flat of Langstone's top must therefore have been further minutely emphasized by the raking of its soil through hundreds of years.

But the chief lesson of the records is that the landward face of this piece of coast was modelled by the railway age which cut it seawards in one brief quarrying moment of history as the sea has been cutting landward over the ages. The width of the railway allows for the public right of way between the rail track and the coast and the total width of the opening thus made was enough to intersect the sea-face of the cliffs where they are indented by a salient of the sea (Fig. 3). At this inlet a short seawall divides Langstone Rock into two where once were two little promontories. The need to protect the railway has led to the protection of the rock, and much of Langstone Rock near sea level is reinforced by stone walling sometimes shaped to the form of the rock which thus creates a defensive architecture whose lines are guided by nature. A mole, sea walls and the surfacing of parts of the base of the columns of the caves are some of these additions to the structure. With the right document and good eyesight the direct effect of the steam engine on Langstone Rock is evident. The indirect results however are incalculable as no one can measure the changed stress of the sea denied its attack on the cliffs west of this corner by the building of the railway and its sea wall all the way along the beach to Dawlish. Nor can one be certain, though one may conjecture, that the embankment to the northeast has concentrated the attack of southeasterly gales in this corner. Absolutely certain is the halting of the supply of much protective beach material to the rock platform east of the mole.

The twin features that make up Langstone Rock today however owe most of their shape to the guidance afforded to erosion by the distribution of textures within the mass and by the patterns of bedding

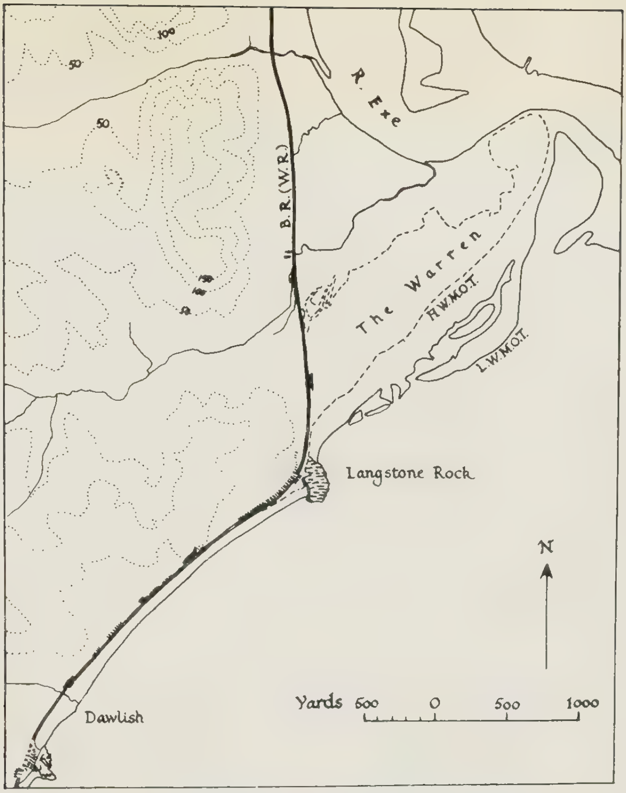

Fig. 1.—The position of Langstone Rock.
(Based on O.S. map 1:25,000 SX97. Crown Copyright reserved.)

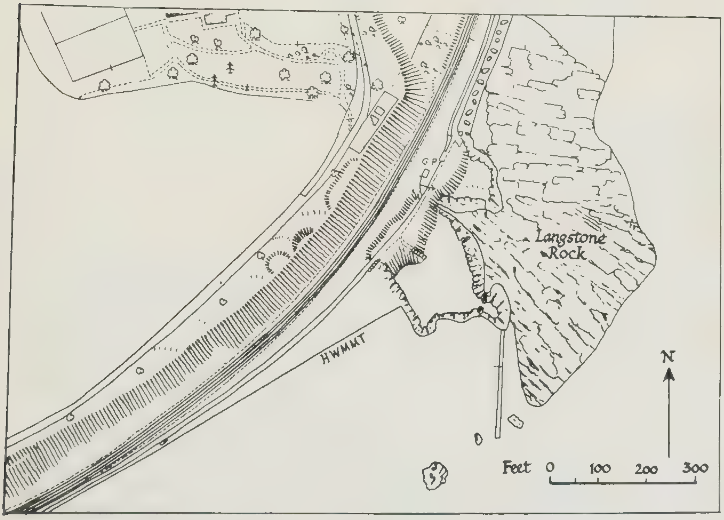

Fig. 2.—Langstone Rock.
(Based on O.S. map 1:2,500 SX9778. Crown Copyright reserved.)

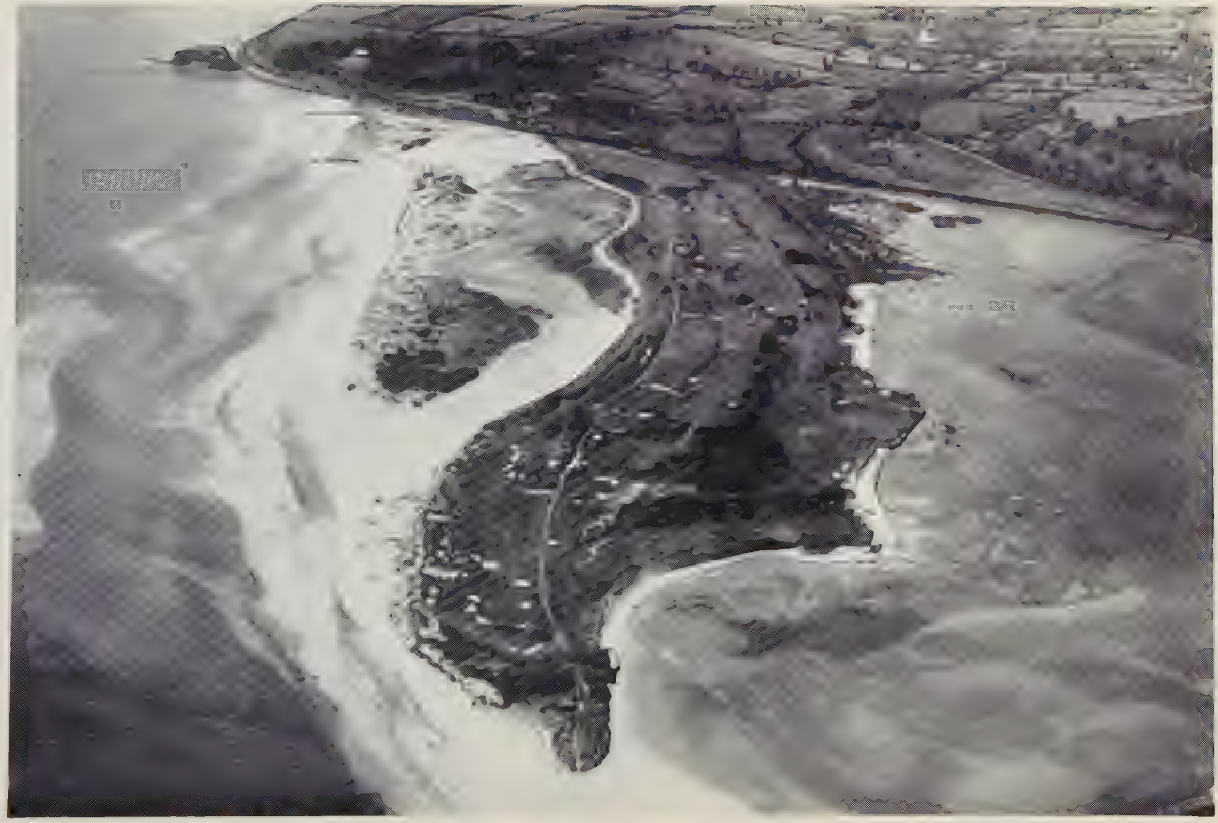

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Plate I. Air view of Dawlish Warren, with Langstone Rock at top left of photograph.

planes and joints. The whole is shaped from deposits of ancient subangular fragments out of the middle of some Permian desert basin, stones, gravel and coarse sand quite well cemented, roughly graded, and "deeply stained with red oxide of iron".[9] The coarse or fine beds of breccia[10] emerge now at one level, now at another, sometimes to rebuff and sometimes to aid the attacking elements. The broadest division is between a lower brecciated bed rising from the sea to about 25 feet in height at its southwestern end but only to about 10 feet on the northeast, and the finer sandstone beds above. These upper and lower divisions greatly determine general shape as the southwestern face is thus much more resistant. Further the multitude of minor changes in the fragment size contributes to the characteristic honeycombing (Plate II).

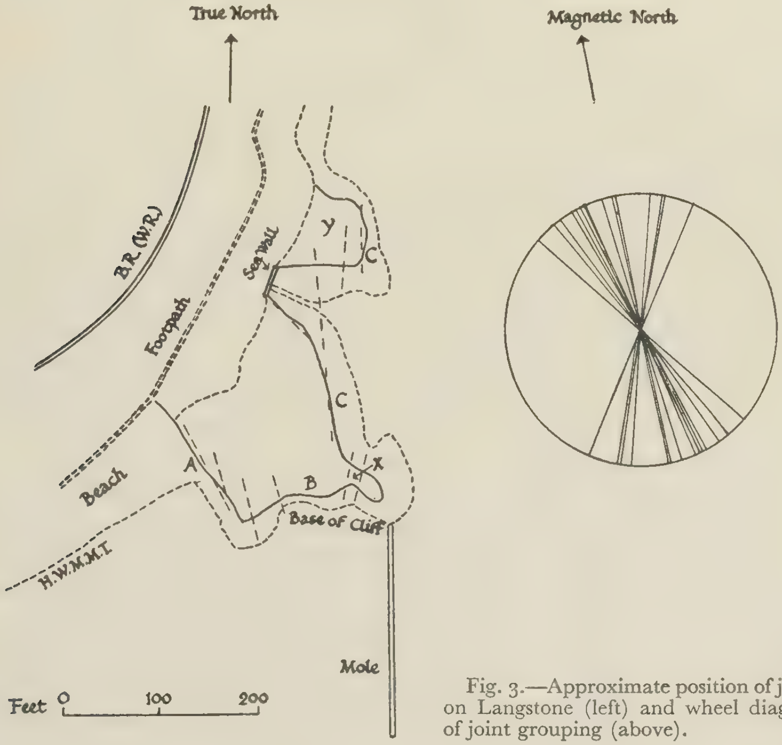


Fig. 3.—Approximate position of joints on Langstone (left) and wheel diagram of joint grouping (above).

Bedding planes whatever their cause[11] play more than a little part in general shape too. Though quantitative assessment is again impossible, there is a marked relationship between the fast eroding east and northeastern sides and the seaward slip-off slopes, while the slightly landward bedding dips of the southwestern face may well account for its prow-like seaward profile (Plate III).

Last but by no means least is the importance of joints in the general form of the Langstone headland. Though the materials of this concreted mixture are seemingly loosely thrown together, the very existence of cracks and small faults is a measure of its compactness. The plan of Langstone on the map shows it to be severely indented by the sea while the many caves and arches that the map does not reveal are other zones of exploitation by the waves. The straighter faces of the rock, the fault-guided inlets and the numerous tunnellings and burrowings are all guided by joints of consistent grouping (Fig. 3 and Plate V).

The natural faces of Langstone Rock are many, but, partly aided by the artificial boundary of the mole, definition is possible of a southwestern, a southern and an eastern side (A, B, and C, Fig. 3).

The southwestern face (A) is a bluff squarish shape, roofed by a perfect plane which tilts very slightly away from the land and lies in perfect conformity with the neighbouring inland marine-cut surfaces[12] (Plate I). Its vertical seaward profile bulges out over the beach and the base line of the cliff follows the steps of the shingle ridges which come and go in the corner between the rock and the railway's sea wall. On the railway side the outline is a confused tumble, a compromise between nature and the engineer. The face itself on this side is an outcrop of breccias which are fairly coarse[13] and the angular stones sticking out of the gravelly matrix are like a studded shield or the broken bottles on an orchard wall (Plate VI). This armoured barricade standing square to the southwest winds protects the soft heap behind and prompts the thought that had there been a reversal of either geology or winds the whole might now be destroyed. An embryonic honeycombing is found above high-water level as if the sea had washed away the pock-marks lower down as it does the footprints from the beach. But these pocks are really the work of the wind eddying in the hollows left from fallen stones, or opened along the ill-defined cracks in joints or in beds of differing hardness (Plate II). To just which of these causes should be assigned each hollow shape only an ageless sleepless eye could tell, but the cliff faces that are protected from strong winds noticeably lack these shapes.

Two small caves low down on this face, their presence almost completely camouflaged by the dewlap drop of their outer walls, run landward and northward at very acute angles and only serve to emphasize by contrast the general blankness of the surface (Plate III).

The sea-facing southern side (B) is in contrast deeply caved. The narrow crack near the western limit of this face is followed eastwards by progressively larger burrowings as the coarse breccias tilt downwards to some twelve feet or so above beach level and fine-grained beds and softer sandstones appear above them speeding collapse of cave-roofs and enlargement of the openings. Finally there is a complete breach at the southeastern corner revealing through the natural arch the shadowy eastern side (Plates IV and V, and X in Fig. 3). The rock is therefore well seen from this direction against the backcloth of the sky so that the concertinaed ribs of bedding of differing resistance stand out on the many profiles.

The wind, more discriminating in detail if less penetratingly powerful, has aided water in its destructive work. High on the cliff-front the gales have taken bites at the same areas of weakness as the sea has chosen below; but these curving walls, perhaps the flattened-out remains of raised fossil sea caves, are spun into shapes like a bowl's side from the flying grindstone of grit and sand in the eddying air. But the stabbing, flapping tongue of the sea and its teeth of flint[14] have bitten and sucked at the cracks and gone far in, the tension in the rock being surprisingly great enough to support an overhang of such looseness and brittleness.

The east side of the main rock (C) has a solid wall of coarse sandstone curving away from the arch and largely convex from top to bottom like a bent back taking a strain. East of this again and cut off from the rest by a narrow gully a most deeply undercut relic still stands where all the forces of erosion seem to have laboured destructively to wash and tear it away (Y, Fig. 3). Here above the larger caves the sky appears in a great blow-hole so that the modelling is carried triumphantly through to a full conclusion and the shapes are those of the subtle growth-like forms of Henry Moore.

To west, south and east the beach is in part, and the sea floor completely, formed from the same rock as Langstone, and so may be considered as working and structural parts of it. On the west the gales and waves have built ridges of shingle sometimes slung round to face more nearly the southwesterly winds. Forced into a corner here the debris rises and probably protects the already stronger western side from much regular tidal attack. But the really big gales reach it and seasonally the beach moves up and down like a slower tide. Summer swimmers rarely see the lethal-looking iron spars of old war-time tank traps which emerge when the down-cutting storm waves begin each autumn.

On the south side the shingle and sand is kept at a lower level, for although a mole extends from the southeast corner of the rock, the beach material sifts away though the archway. At low tide the sea-bed is seen to be much flatter, a slime-covered platform of rock, the uncovered base of the headland which nearer the cliffs is buried under the beach by the halt of longshore drift.

The shore on the eastern side of Langstone Rock is a weed-covered natural causeway[15] (Plate V). The slabs of soft stone are easily rounded by the tools of the sea, and the dip of the bedding seawards forms long lines of pillow shapes slightly overlapping and striking from north to south. Only a small sprinkling of pebbles litters the platform waiting for the next tide to hoist them into the caves where they rattle as in a concrete mixer. Large stones are the most common because all the finer stuff can more quickly be moved eastwards from this point out on to Dawlish Warren. Little is fed in, and most is swept out of this place, and the sea's attack reaches well up the sides of the cliffs. The soft rock platform itself is good anchorage for the black and emerald green weed which, revealed at low tide in the sun is touched with a blue sheen like the sleeked fur of a wet cat's back.

On the inland face of Langstone Rock the wear of children's summer shoes as they slide down its tempting and dangerous slope is the last —and who knows if not the speediest—of the processes of decay.

REFERENCES

[1] W. G. Hoskins, *The Making of the English Landscape*, London, 1957.

[2] W. G. V. Balchin, *Research in Geography*, University College of Swansea, February 1955.

[3] Tudor David, "Against Geography," *University Quarterly*, May 1958.

[4] This is not to say that completeness is a quality that has no place in art, merely that a work of art is possible without it.

[5] The only difference between these relationships and those of creative science is in the forms of expression through which they are achieved.

[6] W. G. Hoskins, *op. cit.*, p. 17.

[7] Tithe map and apportionment for Kenton parish, 1840. Devon County Archives.

[8] Proposal map, South Devon Railway, 1843, Devon County Archives.

[9] A. Irving, "The Red Rocks of the Devon Coast." *Quart. Journ. Geol. Soc.*, vol. 44, 1888, pp. 149–63. Note: Irving describes Langstone Rock as "less uniformly brecciated" than the "bold section between Dawlish and Teignmouth".

[10] W. Clayden, *History of Devonshire Scenery*, Exeter and London, 1906, pp. 83–90.

[11] Whether the undeniable tilt of the roughly graded and much interwoven beds is the angle of rest of the fans of desert debris, or the false dip of current-bedding or the true dip of the kind associated with the secondary strata of England is very difficult to say. The great local variations in this dip, north-south at Dawlish nearby, east-west at Langstone implies that Clayden's view (*op. cit.*, pp. 85–86) of the importance of scree and fan slope angles should be taken seriously.

Also W. A. E. Ussher, in *Geology of the Country round Newton Abbot*, Mem. Geol. Surv., London, 1913, referring to the coast in general hereabouts, says "the beds and bands of breccia (are) sometimes lenticular . . . with marked indications of false bedding".

[12] The average height of Langstone Rock is approximately 50 feet. This surface with its capping of gravels is traceable inland and along the coast for distances of up to half a mile. It is thought that this may represent an estuarine shore line comparable in level and age to the 65–feet strand line of Penlee.

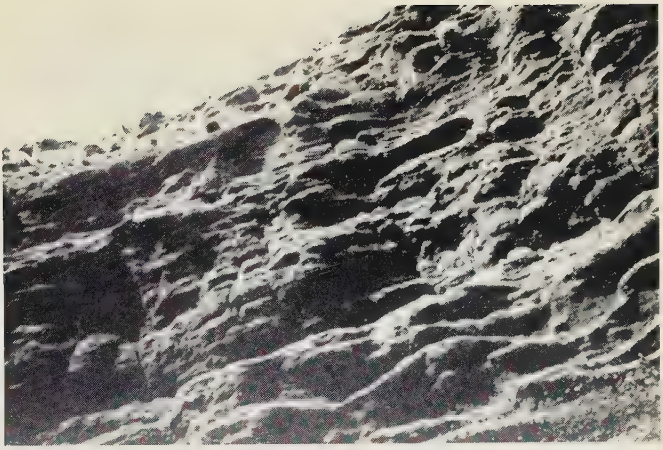
See H. Dewey, "British Regional Geology", *South West England*, London, 1948, p. 67.

[13] The largest stones are about 6 inches along the longer axis. The average size of stones is about one and a half inches square. The binding matrix is of microscopic grains combined with small gravel-size grains.

[14] The present beach, unlike the breccias, derives in part from deposits which include flint or flint gravels. The smaller flints of this beach may come from the same disputed source as those of Start Bay, but the many much larger flints here suggest a relationship with the Haldon gravels. (R. H. Worth, *Trans. Devon. Assoc.*, vol. 36, 1904, vol. 41, 1909, vol. 55, 1923; W. A. E. Ussher, "Excursion to the Dart, Prawle and Bolt districts," *Proc. Geol. Assoc.*, vol. 17, 1901, pp. 119–34, and *The Country round Kingsbridge and Salcombe*, Mem. Geol. Survey, London, 1904.)

[15] This is eight feet or so below the level of the beach west of the mole in summer which may be banked even higher in the winter months.

Plate II.
Honeycomb weathering on Langstone Rock.



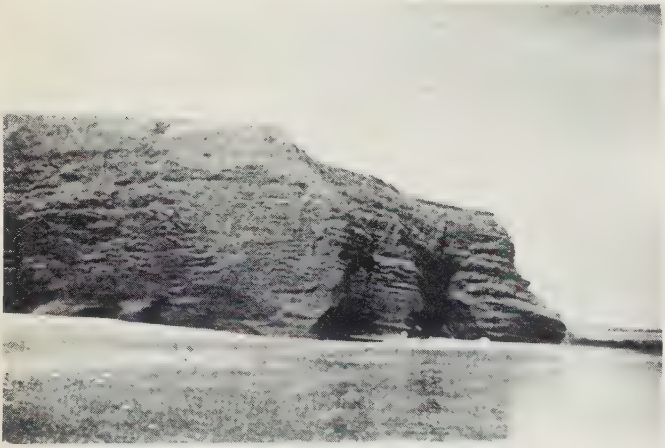
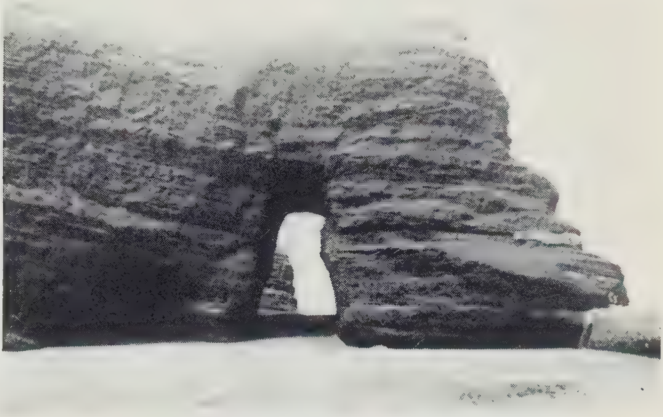


Plate III.
Langstone Rock, south-western face.

Plate IV.
The natural arch.



Photographs by E. Johns

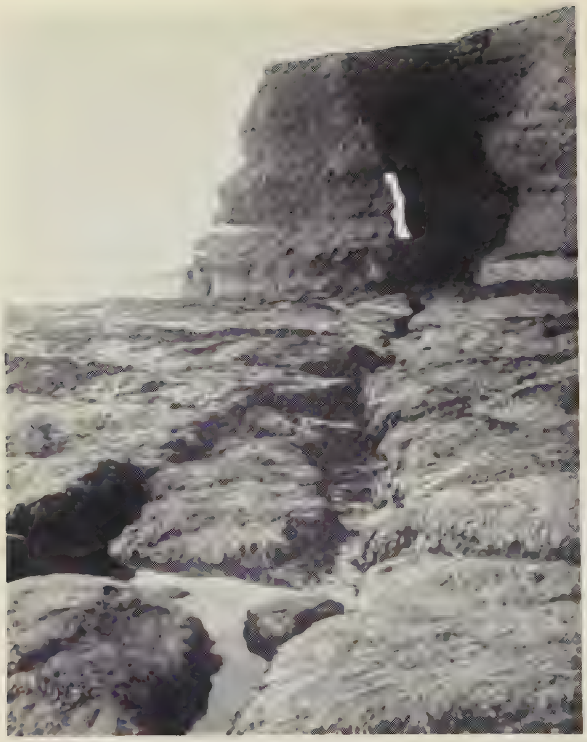


Plate V.
Langstone Rock
from the east.

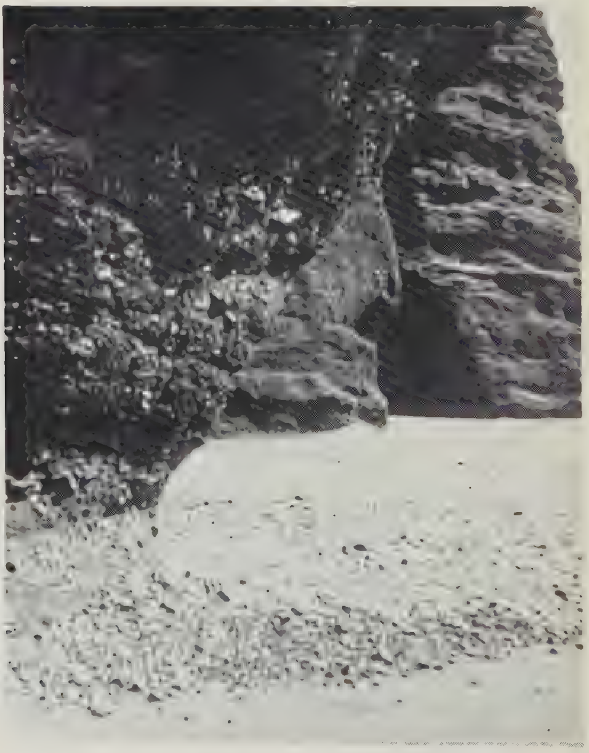


Plate VI.
Close-up of the
breccia of
Langstone Rock.

Photographs by E. Johns

Ebb-flood Channel Systems in Sandy Bays and Estuaries

A. H. W. ROBINSON

THE SUCCESSIVE SOUTHWARD ADVANCES of the ice sheet across the North Sea and Irish Sea basins during the Pleistocene Period led to the deposition of a great thickness of glacial debris, mainly sands and gravels. During the subsequent rise of sea level these deposits were re-worked and re-distributed by waves and tidal streams with a general tendency for the material to be transported landwards. As a direct consequence of this the marginal bays and estuaries of the North Sea and Irish Sea are choked with sand and other deposits derived from the seaward area. The existence of this thick cover of transportable sediment has led to the formation of a distinctive pattern of submarine configuration in many of these shallow-water areas. Tidal streams, operating with constancy of direction and great regularity, have been largely responsible for this development. On the rising tide the flood stream runs in one direction for just over six hours, before turning and running in the opposite direction as the ebb stream for approximately the same length of time. Given an adequate thickness of unconsolidated bottom sediment capable of being transported by tidal streams whose velocity seldom exceeds three knots, a number of elongated channels and banks will be created parallel to the main direction of stream flow. The channels fall into two distinct categories depending on the direction of net transport of sediment. Because the vector sum of flood and ebb stream velocities in any given channel is not usually equal and opposite, there is a residual flow in one direction in every tidal cycle. Depending on the direction of this flow, van Veen suggested that the terms flood and ebb were applicable to the distinctive channels.[1]

The flood channel running in from seaward is deep at its outer end but gradually shallows to a sill or bar at its head. The opposing ebb channel often represents the seaward extension of the river bed into the estuary and can be deeper in its inner section than at its seaward end. The two types of channel tend to be mutually evasive with the result that interdigitation is common. This is principally due to the momentum of flow of the tidal stream causing a time lag. If the ebb stream is running out of the estuary, it will continue to flow for 20–30 minutes after low water even though the flood tide is rising and the associated stream is beginning to run into the estuary. The flood stream therefore tends to avoid the outgoing stream and cuts a channel alongside the ebb channel. The actual pattern of the opposing channels

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➤ Dr. Robinson is a lecturer in geography in the University of Leicester. His paper is based on a lecture delivered to the Spring Conference of the Association at Leicester on 3rd April 1959.

varies from a simple parallel arrangement to a more complex double barb or snake tongue plan (Fig. 1). In each case, however, the flood and ebb channels are quite distinct and are separated by a shallower sill or bar.

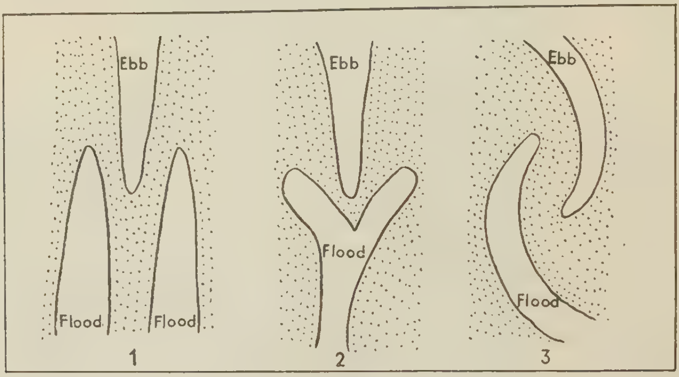

Fig. 1.—Various patterns of the mutual evasion of the ebb and flood channels. 1—Parallel; 2—Snake tongue; 3—Flank.

The pattern of the whole system of ebb and flood channels displays a close relationship to the shape and situation of the bay or estuary. In a bay on an open coast where the linear tidal streams are approximately equal and opposite, the ebb and flood channels are correspondingly equally developed. In a more enclosed bay like the Wash where the amount of river water is relatively small compared with the tidal circulation, the flood channels are the dominant element. In such a situation, in spite of the additive effects of the river water, the tidal characteristics are such that the flood stream runs more strongly than the opposing ebb. Where the estuary has a bell-mouth shape, as is the case in the outer Thames seaward of the Nore, the same asymmetric tidal curve is apparent and the flood stream has a greater maximum velocity than the ebb. For the Thames, however, the amount of land water entering the estuary is considerable and well-developed ebb channels are apparent running seaward from the rivers Thames and Medway as well as smaller ones off the mouths of the Crouch, Blackwater, Colne and East Swale (Fig. 2). The ebb channel never attains the depth of the flood counterpart for in an estuary where two water masses are in circulation, the flood stream, being more saline and therefore of greater density, tends to flow as a bottom current whereas the ebb stream with its added fresh water is more of a surface current and not capable of scouring the channel bed to the same extent. At the meeting of the two water masses of differing characteristics as, for example, at the turn of the tide, the saline flood forms an undercutting wedge with the lighter fresh water riding above it. The boundary layer, both in section and plan, is usually distinct and very little mixing occurs so that the line of junction between the green saline flood and the contrasting browner ebb waters can often be seen quite clearly. Even where the salinity gradient between the surface and bottom waters is relatively small, as in the River Thames where it amounts to about two parts per thousand, there can be a considerable differential movement of the two water masses. Experiments in Gravesend Reach have disclosed that the bottom waters can have a net drift in the direction of the flood of almost two miles per tide while the surface layers are moving seaward by almost the same amount.[2]

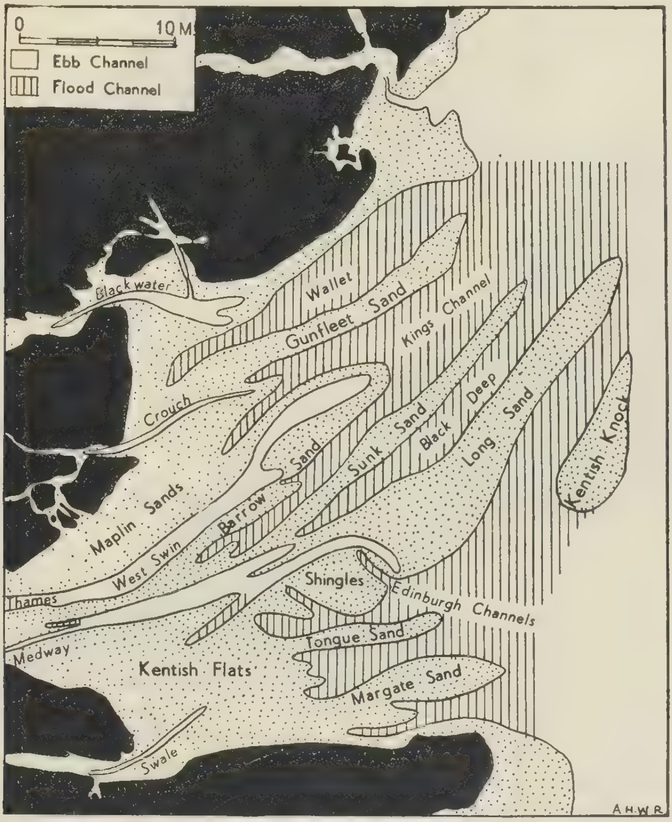

Fig. 2.—The ebb–flood pattern of channels in the bell-mouth shaped outer Thames estuary.

Where the estuary is long and narrow and the amount of river water in circulation is considerable as, for example, in the Humber, the ebb channel may be the dominant element in the bottom configuration. In its characteristics and behaviour, the ebb channel is similar to a normal mature river course with well-developed meander loops and isolated hollows or swales in its bed. The only impression the flood stream makes in such a situation is to create a number of barbs running into the bordering sand and mud flats at points where the ebb channel changes direction (Fig. 3). The flood barbs are all short and blind and quickly end in an abrupt head. The only really well-developed flood channel lies at the seaward end of the Humber south of Bull Sand. As elsewhere it is separated from the opposing ebb channel by a sill which, however, has sufficient depth of water over it to allow safe passage at all states of the tide.

The ebb-flood pattern of channels is seldom a stable bottom configuration. Small variations in the relative strength of the tidal streams, changes in sediment supply and the influence of episodic storms when wave action plays a more prominent part, are all likely to bring about a change and make future prediction hazardous. For certain ebb-flood channel systems which are of great importance from a navigation standpoint, there is a wealth of data relating to the changing bottom configuration so that although the reasons for the changes are not clearly understood, it is nevertheless possible to analyse past bottom movements. The Edinburgh Channels swatchway* in the outer Thames Estuary, one of the most important navigable channels in the world, has a wealth of survey data and can therefore be used to study aspects of loose boundary hydraulics.†

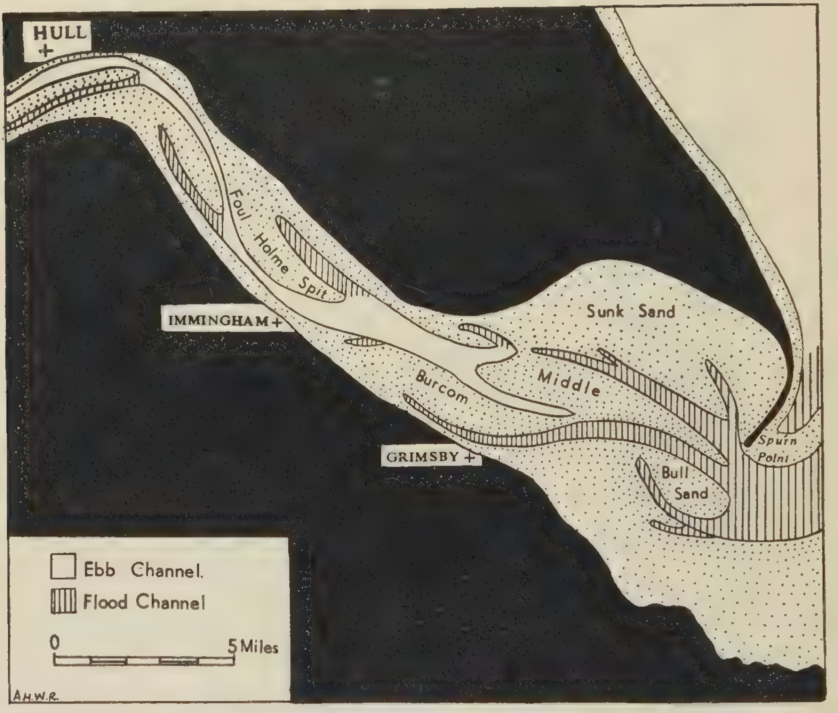

Fig. 3.—The pattern of channels in the narrow estuary of the Humber with the ebb channel as the dominant element.

The swatchway owes its origin to the later-arriving Dover tide meeting the Long Sand at right angles at a time when the main North Sea tide is on the turn. Surveys undertaken during the last century show that initially the swatchway consisted of a single narrow channel.

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* A short transverse channel across an elongated sandbank.

† Loose boundary as opposed to solid boundary hydraulics is concerned with flow in channels whose sides are liable to change through erosion or deposition.

Subsequent erosion of the margins of the channel led to a considerable increase in width with the result that the tidal streams were unable to maintain the original depth throughout, and a shoal, Shingles Patch, began to develop between 1863 and 1881. From this time the dual swatchway of the North and South Edinburgh Channels has existed. At first both channels were of the flood type with their shallow sill abutting the Black Deep; subsequent alterations in the shape of the Shingles Patch and the adjoining banks of the Long Sand and Shingles Sand gradually transformed the North Edinburgh Channel from the flood to the ebb type.[3] The present pattern of bottom configuration therefore comprises a flood South Edinburgh Channel and an ebb North Edinburgh Channel with the ever-growing median shoal of Shingles Patch between them (Fig. 4).

Since 1926 the swatchway has been surveyed every two or three years on the exceptionally large scale of six inches to a nautical mile. It is the data obtained from these hydrographic surveys that has been used in the subsequent analysis. In order to assess the significance of the changes in bottom form, a number of isallobath maps* for different periods was prepared by superimposing the fathom lines of successive surveys and plotting the intersections as points of positive or negative change. Isopleths were then drawn in relation to these points to demarcate areas where shoaling or deepening had occurred in the intervening period (Fig. 5). The isallobath maps clearly show that the most significant changes in sea-bed configuration tend to take place along narrow belts bordering the edge of the sandbanks. By plotting the axes of the various belts on a single map, an evolutionary picture of growth stages over a longer period can be obtained (Fig. 6). Between 1926 and 1958, the years covered in the study, there was consistent widening of the swatchway brought about by the erosion of the edges of Long Sand and North Shingles Bank. As the operative tidal streams which attempt to maintain the swatchway have probably remained almost constant, the wider channel has led to a dissipation of energy over a much greater area and led to the extension of Shingles Patch along both its southern and northern margins.

The changing shape of Shingles Patch can be best understood if it is considered as an obstacle offering resistance to the stream flow acting upon it. To take the simplest case, suppose the obstacle is an inclined plate (Fig. 7). The parallel stream lines on meeting the plate will be deflected by it, coming closer together on the underside and spreading out on the upper side. There will be a considerable difference of pressure exerted on opposite sides of the plate, positive on the underside and negative on the upper side where a 'void' will develop. The shape mapped out by the stream flow lines and one best adapted to take advantage of the least resistance to the forces acting on the plate will be an aerofoil (hydrofoil). In the hydrofoil, the intensity of pressure varies on different parts of the exposed surface (Fig. 7). Pressure is greatest along the line of the leading edge but falls off rapidly along the upper face so that on the back there is a zone of negative pressure. Along the lower face the comparable zone of negative pressure is much more limited.

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* Showing areas of equal change of depth.

These theoretical considerations can now be applied to the development of Shingles Patch. If the median shoal is considered as a double

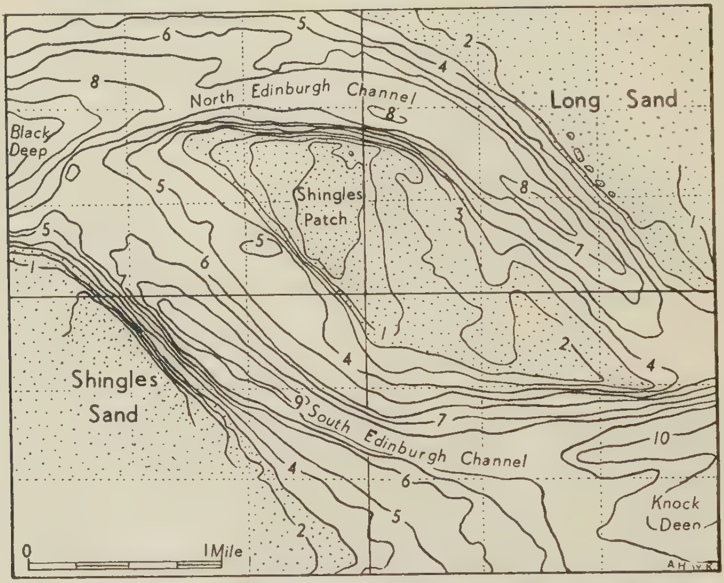

Fig. 4.—The submarine configuration of the Edinburgh Channels swatchway.

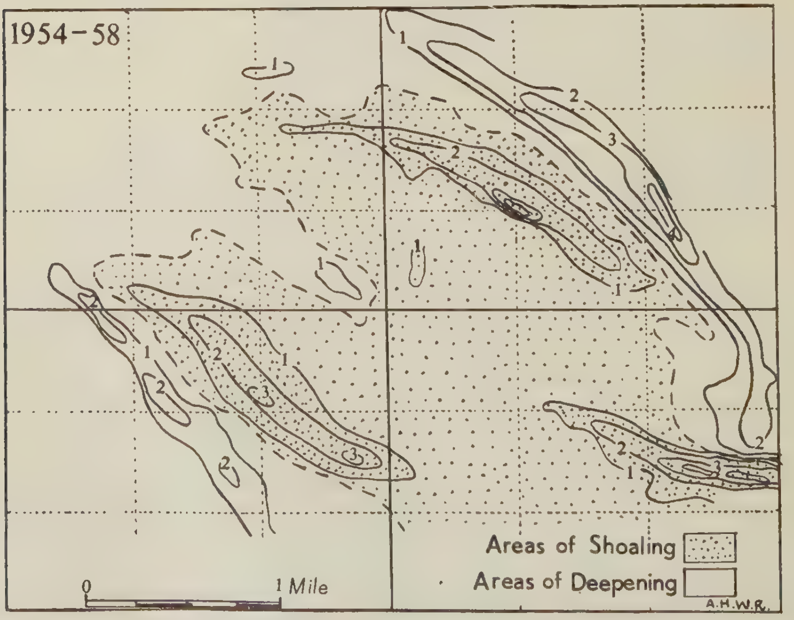

Fig. 5.—Isallobath map of the Edinburgh Channels swatchway for the years 1954 to 1958.

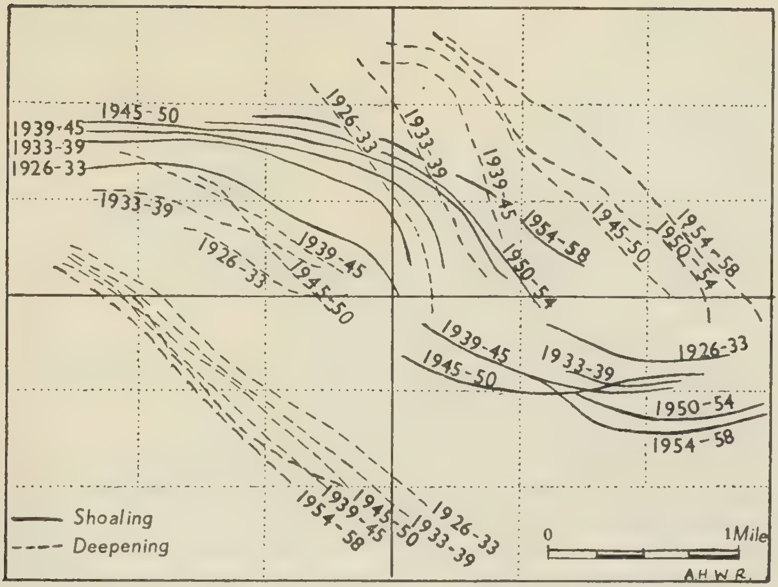

Fig. 6.—The axes of the belts of shoaling and deepening along the margins of the Shingles Patch and adjacent sandbanks as indicated on the isallobath maps constructed for varying intervals between 1926 and 1958. Other less significant belts, as, for example, that shown in the southwest quadrant of Fig. 5, are omitted as they indicate a general shoaling in the deep water of the channel.

hydrofoil with its leading edges facing the residual ebb stream from the Black Deep and the residual flood from the Knock Deep, it is apparent that the areas of consistent shoaling, as shown on the isallobath maps, coincide with zones of negative pressure (Fig. 8). Conversely the areas where deepening has occurred are related to zones of positive pressure, although here the relationship is not so clearly established. Strict accordance is unlikely in view of the many variables involved. It must also be remembered that the Shingles Patch is a complex three-dimensional form whereas in the theoretical example quoted in illustration, a simple inclined plate was postulated.

The changing pattern of the ebb-flood systems of banks and channels has far-reaching consequences in many different fields. The important role they play in navigation and port approach channel maintenance hardly needs stressing but the influence they have in certain aspects of coastal development, land reclamation, sewage disposal and inshore fisheries is less obvious.

Navigation and port maintenance

The fact that most of the larger ports of the British Isles lie at or near the head of sand-filled bays or estuaries poses problems of considerable magnitude relating to the maintenance of adequate navigable approaches. Of the nine major ports listed in Table 1, only Southampton and to a lesser extent Swansea are not faced with

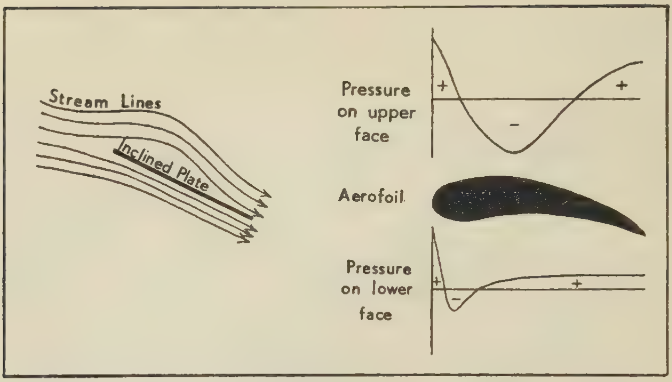

Fig. 7.—The principle of the aerofoil and the variation of pressure on its upper and lower faces.

problems resulting from the existence of the ebb-flood pattern of bottom configuration. The actual depth of water in the individual channels seldom gives cause for anxiety. Even for the ebb channel towards the head of the estuary, insufficient depth even at low water spring tides is not usually a serious problem especially as dredging is nearly always practicable here. The least depth of water along the whole length of the navigable approach channel commonly occurs in mid-estuary on the sill between a pair of mutually evasive flood and ebb channels. Thus in the outer Thames Estuary, there is at least depth of 4 fathoms on the sill between the Barrow Deep (flood) and West Swin (ebb) compared with depths of 12 and 11 fathoms respectively in the two channels. Dredging could increase the sill depth but the relatively exposed position in mid-estuary would lead to difficulties not encountered within the more sheltered situation at the head of the estuary.

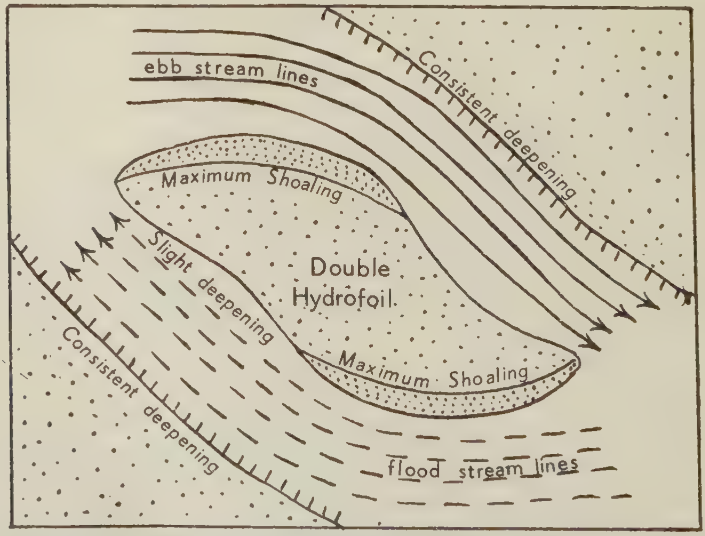

Fig. 8.—The growth of the 'double hydrofoil' of Shingles Patch in response to the tidal stream forces operating in the Edinburgh Channels swatchway.

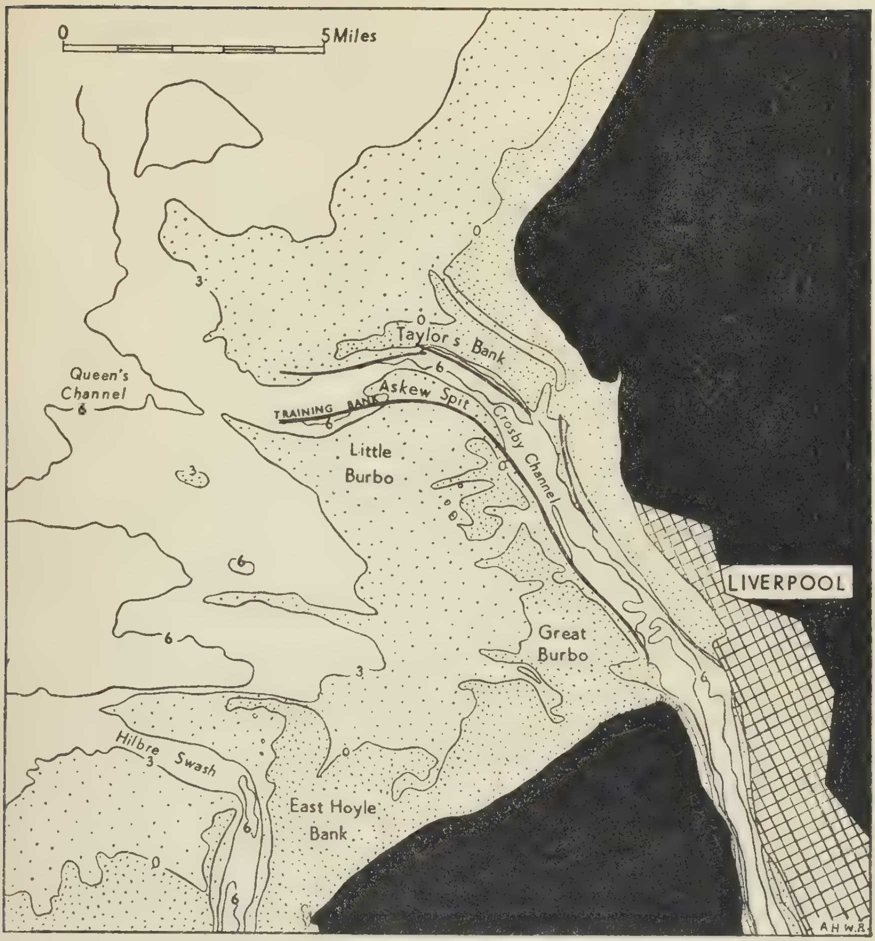

Fig. 9.—The submarine configuration of Liverpool Bay showing the training banks constructed in an attempt to stabilize the channel.

In any case the increase in depth would only be temporary for dredging would be in opposition to the operative natural forces.

Table I

Trade of the Principal Ports of the British Isles (1956)

Port	*Value in million £*	*Tonnage in million tons*
London	2472	36·8
Liverpool	1653	18·4
Manchester	408	7·2
Hull	376	5·7
Southampton	315	20·3
Glasgow	291	7·2
Bristol	169	4·9
Tyne Ports	123	8·1
Swansea	115	4·9

The same problem of a shallow bar in the outer part of Liverpool Bay has given rise to numerous problems connected with the maintenance of a deep-water approach channel to the Mersey ports. The bar lies between the Crosby Channel (ebb) running out of the Mersey Estuary and the opposing Queen's Channel (flood) running in from seaward (Fig. 9). Since Commander Denham attempted to remove the bar in 1838 by using an improvised 'harrow' (a log with iron spikes driven into it), the depths in this section of the navigable channel have proved a considerable embarrassment to the port authorities, vessels often having to wait for considerable periods for the tide to rise. The relative instability of the Crosby Channel, with its tendency to cut into the marginal banks, also added to the difficulties. The building of the training bank, at first along the edge of Taylor's Bank but later extended to cover the margins of other banks as well, overcame this difficulty. By confining the Crosby Channel between the training walls the ebb flow was concentrated but up to the present it has been unable to remove the bar at the seaward end. Continuous dredging in this section of the channel is likely to remain a necessity for the harbour authorities. The mutual evasion of the Queen's Channel (flood) and Crosby Channel (ebb) has if anything been accentuated by the training banks; a difference of 6 inches in the water level on either side of the walls can often be observed when the tide is on the turn.

The difficulties confronting the harbour authorities in Liverpool Bay are by no means unique and the same problem of the existence of a shallow bar at the seaward end of the main navigable channel occurs in the bays and estuaries farther north. In the Ribble estuary, training banks have also been built but as at Liverpool they have proved ineffective in preventing the growth of the bar across the channel.[4] The problem is apparently insoluble in face of the form and magnitude of the natural forces operating. In Morecambe Bay an added difficulty is the shallowing which has taken place in recent years at the head of Heysham Lake, a flood channel. If the present tendency continues, the use of the railway port of Heysham will be seriously threatened.

Coastal evolution

Attention has been directed in recent years to the important role of the offshore zone in shoreline and coastal development. In the North Sea and Irish Sea the vast quantities of unconsolidated material lying close inshore are subject to erosion, transport and deposition by marine processes and can, under favourable circumstances, move landward to become involved in beach drifting and other shoreline processes. In the English Channel the paucity of offshore material affords a striking contrast and must give rise to a completely different set of conditions in shoreline evolution.

Whether the movement of the sea-bed material is towards or parallel to the shore depends on the relative roles of waves and tidal streams as agents of transportation. The dominant wave, even with limited fetch, is able to move pebbles of considerable size, particularly under storm conditions and this movement is towards the shore. The tidal streams, even with a velocity of three knots which is exceeded only in exceptional situations, are incapable of transporting stones of even moderate size unless the material has previously been lifted from the sea bed by wave disturbance. For the finer bottom material, however, such as sand, shell fragments and silt, the tidal streams acting with great regularity and constancy of direction are most effective and particularly in the deeper waters offshore they assume the role of dominant eroding and transporting agent. Movement by tidal streams tends to be parallel to the shore although close inshore stream velocities are less and there is a consequent falling off in their ability to transport bottom sediment.

The implications of the above statements concerning the relative effectiveness of wave and tidal stream action can be seen by comparing the coastal changes which have taken place in Sandwich Bay in Kent and Start Bay in Devon. The bottom configuration of Sandwich Bay and the neighbouring area of the Downs is a complex of shoal banks and intervening channels, which can be resolved into the ebb-flood pattern.[5] The system is dominated by the Gull Stream, a flood channel lying between the Brake Bank and the parabolic-shaped Goodwin Sands. In consequence the direction of net transport of the finer seabed material is from north to south, a fact confirmed by the asymmetrical profiles of the sand-waves which develop on the crest of the Brake Bank.[6] The coarser deposits, such as the shingle part of the Brake Bank, are probably unaffected by the tidal stream residuals and therefore it is to wave action that we must assign the role of major transporting agent. Due to the coastal configuration of both sides of the Channel and the widening to form the Flemish Bight, the dominant wave direction is from the northeast. It is largely under this influence that the Brake Bank has shown a steady landward movement since 1795, when the first reliable hydrographic survey was made.[7] The alignment of the pebble ridges which make up the compound spit running north from Deal is also in accord with this dominant wave hypothesis for they trend at right angles to the direction of approach of the most effective waves breaking on this stretch of coast. It thus appears that the shoreline bordering on Sandwich Bay obtains a steady supply of shingle and sand from the adjacent sea bed, material which ultimately becomes involved in beach drifting and kindred processes. Most of the offshore material probably reaches the shoreline in the form of a steady supply of single pebbles although it is conceivable that in the future the whole of the migrating Brake Bank might merge with the shoreline.

In Start Bay, the bottom conditions are very different and afford an example of the negative role of the offshore zone in shoreline evolution. As has been noted already the bed of the English Channel is relatively free from superficial deposits; the only major accumulations of material occur in the protective lee of headlands where they form "banner" banks. The shoal of the Skerries in Start Bay falls into this category, representing an accumulation of sand and shell fragments within the more sheltered waters northeast of Start Point (Fig. 10). The shape of the bank, a half-formed parabola with its nose pointing south-southwest, suggests that tidal streams play a major part in fashioning the submarine morphology. Due to the shape of the adjacent coastline, a major tidal stream eddy exists in this part of the Channel with the result that in Lyme Bay and Start Bay the ebb stream runs south for nine hours out of twelve. The residual stream and therefore the net transfer of bottom sediment is southward, that is, towards Start Point. This conclusion is confirmed by the evidence of hydrographic surveys made in 1853 and 1951. A comparison of these two surveys shows that the Skerries Bank has extended to the south-southwest by as much as 750 feet. No significant shoreward movement can be detected, the 6-fathom line on the two surveys being almost coincident.

The absence of any apparent landward transference of bottom sediment has had important consequences for the adjacent coast of Start Bay, in particular that stretch near Hallsands, one mile northwest of Start Point. At the turn of the century a local contractor was given permission to dredge shingle just offshore from the beach. As a result of these activities, an estimated half-million tons of shingle was taken from a limited stretch of beach fronting the wave-cut bench on which the fishing hamlet of Hallsands was built. In consequence the level of the beach fell by amounts varying from 10 to 19 feet. It was always argued that onshore waves would bring in further supplies of shingle and build up the beach to its former level. After repeated protests from local fishermen and Hansford Worth, the Devon geologist who interested himself in the whole problem, the exploitation stopped but by then irreparable damage had been done. Hansford Worth, to support his argument, carried out a number of levellings of certain beach sections from 1903 until 1924.[8] The same section lines were re-levelled by the author in 1956 and 1957 and an estimate made of the changes in beach profile over a period exceeding half a century. The main conclusion arrived at from a comparison of the levelling data was that the beach had not recovered from the earlier depredations and, if anything, had been lowered still further as a profile of equilibrium was established with a steeply shelving sea bed offshore. The small changes which had occurred could easily be accounted for by seasonal oscillations of beach level.

Although a great mass of material lies stored in the Skerries Bank, at its nearest point barely a mile offshore, it is clear that a negligible amount finds its way to the beach to become involved in shoreline processes. This is all the more surprising in view of the fact that the length of fetch from the east is considerable. It can only be concluded, therefore, that where the offshore deposits are easily transported by

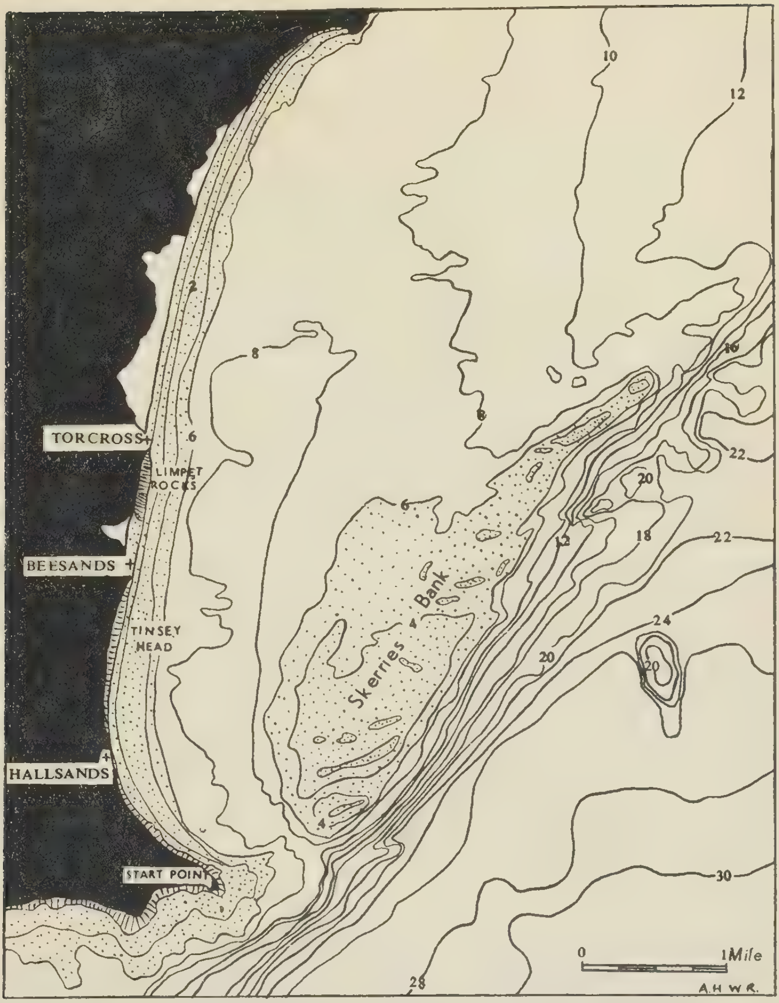

Fig. 10.—The submarine configuration of Start Bay off the coast of southeast Devon. Depths in fathoms.

tidal streams, as for example the sand and shell fragments of the Skerries, the ever-acting streams are more effective than waves in moving the sea-bed material. The fact that the streams set parallel to the shore has meant that the sand and shell fragments they carry make no direct contribution to the beach deposits. The shingle of the beach fronting Hallsands is best regarded as an inheritance from the past. Once removed by man, it is unlikely, bearing in mind the operative marine processes and the relative scarcity of shingle in the offshore deposits, that it would be replaced.*

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* Detailed evidence in support of these conclusions, based on beach surveys and hydrographic studies offshore, will be published in *Geographical Journal*, vol. cxxvi, December 1960.

Biological implications

The existence of two different water masses of differing physical and chemical characteristics in estuaries has important consequences for animal and plant life living in such an environment. Although the whole problem has only begun to be investigated, some important deductions have already been made in relation to the oyster fisheries in the southern part of the outer Thames Estuary. In August 1955, F. Evans and G. E. Newell made a series of current measurements at the entrance to the East Swale between the Isle of Sheppey and the north coast of Kent.[9] The results of their observations using a floating logship showed that a pronounced ebb residual existed so that the net movement of surface water to the northeast might be as much as two miles in a single tidal period. The observations also served to provide independent evidence of the existence of a major ebb channel in this part of the estuary, as shown on the map (Fig. 2).

The existence of a pronounced ebb residual means that free living organisms which are unable to offer much resistance to the stream are liable to be carried to the east by as much as 20 miles in a week. Thus the oyster larvae which have a pelagic life of from 11 to 14 days can be carried a considerable distance from their spawning ground before they metamorphose and settle on the bottom. The famous oyster beds at Whitstable must therefore be repopulated from a site well to the west, possibly near Milton Creek in the Upper Swale. As the number of breeding oysters here has decreased considerably in recent years due to neglect of the beds, overfishing and pollution, it is in this area, rather than at Whitstable Flats, that the solution to the decline of the oyster fishery might be sought.

Disposal of waste

The oscillatory motion of water masses in estuary regions has an important bearing on the problem of disposal of waste, either sewage, industrial effluent or material dredged from docks and navigable channels. Measurements made in the Thames showed that a subsurface float took 7½ days in winter and 19 days in summer to cover the 70 miles of the tidal course from Teddington to Southend. During its zigzag course in summer the float covered a total distance of 844 miles.[10] Although this experiment conclusively proved that there is a net seaward movement of the upper layers of water, there is more recent evidence of the net movement of the bottom waters in the opposite direction. As mentioned previously, measurements made in Gravesend Reach show that near the river bed there is a marked landward (flood) residual approaching two miles in a single tide under summer conditions. Similar measurements made in Lower Hope Reach and Long Reach confirmed the existence of a flood residual near the river bed.

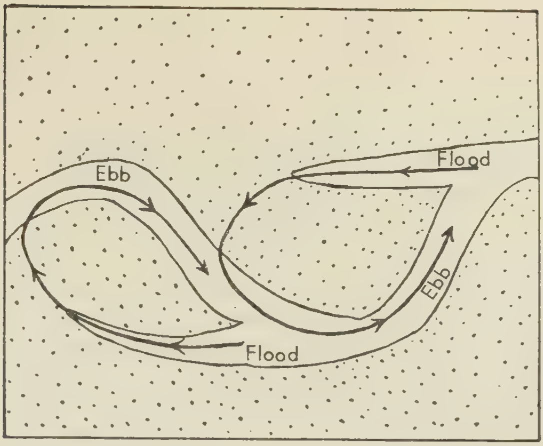

Fig. 11.—The closed cell pattern of circulation often developed in a narrow estuary where there is a dominant ebb channel. During the period when the ebb tide is running, the clearer surface waters will follow the main ebb channel but the heavier bottom current laden with silt will cross the sill into the flood barb and in this way contribute to the maintenance of shoal water here.

In the Humber estuary where the main axial channel is fashioned by the ebb residual, the numerous flood barbs arising from it give rise to closed cell circulation units. On the flood, material is carried along the bed of the flood channel towards its head and some of it is carried across the bar into the main ebb channel farther upstream. On the following ebb the material is carried downstream again to be caught up once again by the flood stream (Fig. 11). In such a closed cell pattern of circulation, the lateral transfer of material either upstream or seaward will be necessarily slow with the result that waste products dumped into the estuary can remain in transit for a considerable time.

Some idea of the magnitude of the problem of disposal of waste matter obtained by dredging can be gained from the fact that each year three million cubic yards of silt and mud are dredged from the bed of the Thames and the dock basins. For the last half century this material has been dumped in the Black Deep, 20 miles seaward of Southend. As this dumping ground lies in a major flood channel, it is likely that some of the excavated material finds its way back into the inner estuary along with other sediments transported landward by the flood residual. A recent estimate of the possible source of the mud in the tidal reaches of the River Thames has suggested that only about half can be accounted for from land sources; the greater part of the remainder must be brought in from seaward by the bottom flowing residual of the flood stream.[11] The same picture is probably true of Liverpool Bay where the two dumping grounds are similarly placed in flood channels. As it is clearly uneconomic to carry the sludge much farther seaward, the only solution would appear to be to pump the material on to the bordering marshes, a practice already in operation in Southampton Water.[12]

The great increase in the volume of trade effluents discharged into estuaries and the open sea in recent years has drawn attention to the inadequacy of existing legislation in preventing pollution in these areas. The Rivers (Prevention of Pollution) Act of 1951 was not specifically concerned with tidal waters although the Minister responsible could prevent or limit harmful discharges into these areas.[13] It seems likely that in the near future the River Boards will seek an extension of their powers to cover estuary waters as well. Industrial firms, taking advantage of a waterside situation to obtain water for cooling and an easy discharge of liquid waste, will then have to ensure that their effluent pipe is sited to minimize possible noxious effects. For a trade effluent to be least harmful it should pass out of the estuary into the open sea in the minimum amount of time. In an estuary where the submarine configuration exhibits the ebb-flood pattern of channels, discharge into an ebb channel would seem to offer the best means of achieving this desideratum. A complication would arise, however, where differential flow exists between the surface and the sea bed because an effluent denser than sea water might tend to move upstream where the net bottom drift is in this direction. If the effluent contains acid, quick neutralization within a short distance of the outfall is essential and this is best achieved by running the discharge directly into a flood channel where saline water, rich in natural bases, is brought into contact with the effluent on each tide. These examples illustrate the complexity of the problem and emphasize the desirability of making a careful preliminary hydrographic study of the area in order to take full advantage of the natural conditions. This has recently been done as part of "Operation Mermaid" in relation to the proposed discharge of radio-active waste into the sea off the Dorset coast from the Winfrith Heath site.

Outfall and reclamation problems

The problems associated with Fenland drainage and reclamation are well known and have received considerable attention. One aspect which has only recently been investigated is the influence of the hydrographic conditions in the Wash. The dominant feature of the submarine configuration of this area is a series of flood channels which dissect the great expanse of drying sand of the Lynn Flats off the mouths of the rivers Nene and Ouse.[14] The ebb channels running out of these two rivers are much less prominent. Both are very unstable and, particularly in the case of the Ouse ebb channel, the meander loops change frequently to establish a tenuous junction with the heads of the opposing flood channels. The net transfer of bottom sediments in the area of the Lynn Flats is landward, the material often travelling in a series of sand waves. The effect, therefore, is to choke the river outfalls and impede the seaward progress of the silt-laden river water. Only when the river is in spate will flushing occur to clear the entrance but, as the river floods are of short duration, their effectiveness is limited.

The dominance of the incoming flood also means that the seaward transport of riverine silt is quickly arrested beyond the river mouth. Measurements of silt content made by the Hydraulics Research Board in September and October 1957 at various stations in the Wash bear this out.[15] At neap tides the silt concentration was very low at all stations. During spring tides when strong easterly winds were blowing, the silt content of a station located in the centre of the Wash was still low, not exceeding 134 parts per million. For a station near the outfall of the River Ouse, however, the silt content was as high as 1048 p.p.m. at half ebb and rising to 1124 p.p.m. with the onset of the flood.

Much of this suspended material around the margins of the bay and near the river outfalls ultimately makes its contribution to the upbuilding of the mud flats, being spread out as a thin layer between the tide marks during the period when the tide is on the turn and tidal streams are slack. The rate of accretion varies greatly but measurements made by inserting silica plugs in the flats at Butterwick, four miles seaward of the Witham outfall, showed a mean rate of increase of 1·2 inches a year. When it is remembered that the submarine banks in and around the Wash are composed of sterile sand, the importance of this natural accretion process cannot be underestimated. The hydrographic conditions existing in the Wash, therefore, have a credit as well as a debit side in relation to man's attempt to take advantage of and improve upon the natural physical setting of the area.

Acknowledgment. Figures 4, 9 and 10 have been compiled from documents in the Hydrographic Department of the Admiralty with the permission of the Controller, H.M. Stationery Office and the Hydrographer of the Navy.

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The Loess in European Life

H. J. FLEURE

OUTWARD WINDS FROM PLEISTOCENE ICE SHEETS carried fine soil to be laid down, either against the base of an obstacle such as a mountain ramp, or in hollows, or on great stretches of plain. This fine deposit, laid down seasonally, allows plants, especially grass, to grow in it. Seasonal decay and burying of the grass gave organic material to help new growth, and often the withering of a grass-stem left a vertical air-tube. When the last ice-phase passed away, deluges of melt-water and rain spread light woodland on the loess as well as great trees in dark forests on the heavy boulder clay. The case for a certain amount of tree growth on the loess has been cogently argued.[1]

Hunters of the Old Stone Age had long found the loess of Moravia attractive but the spread of grain cultivation from southwest Asia in the early 3rd millennium B.C. gave the loess a new importance. It was friable and easily cleared and worked, and its fertility was helped by its organic content and air-tubes. Professor Clark[2] gives a map of relations between early shifting cultivation and the loess. This seems to have spread, with stone hoes, in Danubia, Czechoslovakia, Poland and parts of Germany.[3] The spread in South Russia seems to have been limited by the long severe winter and the long summer drought. Wheat (either Emmer or a small Spelt) and some barley were grown. Hunting and fishing gave flesh food but men learned to supplement this by capturing a cow with her calf. They then learned to castrate a male calf, so that it grew into the strong and patient ox. Ox and pig gave good flesh food and the cow gave milk, and in due course, butter and cheese. Work was found for the ox, notably in pulling a hard and fairly sharp edge or point forwards through the surface soil, the beginnings of the plough. Difficulties of winter-feed for animals enforced slaughter in November, the end of the annual vegetation cycle. Smoked flesh, salted if salt was available, was winter-diet for man. November 11–12 is the old *Bout de l'an*, the old All Souls' Day, *Calan Ghaeaf* in Wales, and so on*.

Increase of cattle also led to a danger of raids for cattle could be moved on their own feet. Hungary has yielded hints of defensible early villages, so settlement was sometimes becoming more durable, and cultivation less apt to shift and more apt to alternate between adjacent fields in successive years.

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* The "Guy" burned on Guy Fawkes Day in Guernsey is still called the Bou'd'lon, and this reminds us that the 5th November burnings are really the modified "end of the vegetative year".

As time passed, copper ore was found and men learned to shape it by heating and, at first, hammering, and so the metallurgical arts developed first in southwest Asia. But in the transition time from stone to metal in Europe we find evidence of certain rapidly spreading groups coming across the loess from the south-southeast.[4] They are known by their superiority in pots, usually called beakers. Their special pot-making art vanishes after a few generations, and perhaps they were young male adventurers with few women of their own, so they took wives of other pot-making traditions. Professor Chadwick used to think that the Beaker-makers were responsible for the first spread of the Aryan mode of speech.

Clark[5] shows that, in the early metal age, barley had become important and the sheep (probably from the Greece-Mesopotamian region) had spread. Later the sheep of Inner Asia became the chief flocks. Bohemia, with both copper and tin, was naturally a most important loess area. As men learned to mix copper and tin in proper proportion to make bronze, and to melt the metal completely enough to run it into moulds, travelling smiths collected old weapons and tools for remelting. The "tinker" was an outsider and his "cuss" of no account.

At some stage in the development of bronze the horse of the loess was domesticated, at first for pulling a drag or sled. Only later were wheels and riding added to men's equipment and the swifter Asiatic horse spread west from the great steppe.

Increased equipment made larger populations possible. We find large urn-fields or cemeteries. In Bavaria there is evidence of fortified villages and in several regions hints of the presence of overlords from the northeast and of raiders from the steppe.[6]

The Hungarian loess was a corridor, not the Danube at the Iron Gates. Here the great river is confined between cliffs for many miles and cannot have been a line of upward transport until modern times, save for an impressive Roman effort. A narrow ledge on the south cliff was widened by building out planks supported on oblique poles hammered into holes in the rock. So an army was marched up! It has been Carpathian passes that have been trade routes, and the Black Church at Brasov used to have, one hopes still has, a splendid collection of carpets from Asia given by merchants as thanks for their safe return.

Nehring[7] has studied the Aryan languages and traces their origins to the loess area including South Russia and Danubia. No wonder the book was banned by Hitler. On the northern fringe the Teutonic varieties emerged while in the west (i.e. south Germany) Celtic was shaped. Southwards the Graeco-Latin languages evolved. And in the west Ukraine at some stage there grew the Slavonic group. All this may need to be modified but it is more helpful than old hypotheses of waves of language following one another from Inner Asia. Whatever the place and date of birth of Aryan, there seems much reason to suppose that its various forms were taking shape on the European loess in the

Bronze Age. During the later centuries of the Bronze Age the loess lands of Transylvania seem to have had active trade with north Italy across Danubia. There, a number of factors of social life altered and introduced the Iron Age.

To make bronze, copper and tin ores had had to be brought together often from great distances, and supplies were often precarious except in a few places like Bohemia. Iron ore was very widely available and its treatment was relatively simple once the technique of an air-blast through the furnace had been developed. And the iron, still more the steel, weapon was stronger and more durable than any sharp edge in bronze. The horsemen with their swords could go forth and conquer.

As iron spread in Europe in the last millennium B.C. the climate changed. Wet cold summers limited harvests on the loess lands of central Europe though rye and oats spread but the Mediterranean got a better milder climate, one of the factors of the blossoming of classical civilization. On the south Russian loess, cooler summers gave prosperity or opportunity and we have the vivid picture of the Scyths in Herodotus's *Histories*.[8] Horsemen spread west through Carpathian passes into the western loess. Pressure of soldier-groups drifting southward from the cold that northern Europe was undergoing led Celtic-speaking peoples of south Germany to force a way across the loess south-eastwards as far as Galatia in Anatolia, as well as to spread in France and northern Spain and Italy. Usually these soldier-groups married girls of the conquered people and so melted into the local populations.

In a period of vigour (2nd century A.D.) not only did a Roman army march through the Iron Gates, but the Roman Empire also spread its authority beyond the Danubian loess and planted its soldiers in Dacia (part of modern Roumania) where Roman power lasted about 150 years. The Roman soldiers bred a population speaking a provincial Latin which is a constituent of modern Roumanian. On the whole however the loess lands were gathering grounds for attacks on the Roman Empire, and we have Gibbon's imaginative picture of the palace and village of the terrible Attila in the 5th century A.D.[9]

About that time the climate of Europe warmed up and cultivation spread towards the Arctic circle. The south Russian loess in the next centuries saw the passage of conquerors such as Bulgars and Magyars, but also witnessed the increase of population of the Ukrainian and Polish loess and with this the spread of the Slavonic languages. Wendish and Czech and other varieties spread westwards north of the Carpathians while Serbian and related forms took shape westwards south of the Carpathians and Danube. On the loess of the mid-Danube the dominance of Magyar horsemen kept out the Slavonic languages.

The story of language in what had been Dacia is of special interest. The eastern Carpathians have large areas of rolling plateau land rich in summer grass so flocks and herds have been driven up to them especially for May–July. The herdsmen live roughly on the high plateau, isolated by deep wooded glens from their lowland homes. In times of invasion some remained on the high plateau indefinitely. It is in this way that something of the Dacian Latin tradition in languages was preserved, but it had to mingle with Slavonic and so we get the composite language called Roumanian.

The spread of Slavonic was accompanied by another change in this period of rather favourable climate. Iron implements had spread and it was felt to be worth while to cut down large trees and plant villages in clearings and this was happening in the west as well as on the central European loess. German scholars call this period *Die Rodungszeit.* On the Polish loess the villages were not fortified but, at intervals, there were refuges with earth-ramparts. Farther west, in Bohemia for example, towards A.D. 1000 churches and fortresses were beginning to appear, an accompaniment of the renewal of western urban life after the centuries of post-Roman disorder. This western revival gave the Roman Church the opportunity to spread over the mid-Danubian and the Polish loess, and the clashes between this Romanist power and the church influence (Orthodox) spreading from Constantinople led to the formation of the line of division that in our time takes the form of the Iron Curtain.

The climate was changing again, with severer winters, and corresponding pressure of nomads from Inner Asia in the European loess. Poland became an outpost of the west and acquired a specially close ecclesiastical link with Rome and a separateness from the peoples of Orthodox or Constantinopolitan tradition around it. On the loess some of the old-time earthwork refuges became converted into nuclei of cities. The Wawel on the Vistula at Cracow became the castle-cathedral centre to which was added the largely German merchant-city with its fine town church and wool hall and its early university. Jewish immigrants and Polish labourers were other elements in an urban centre far from any close unity of feeling with rural feudal Poland or even within itself. Poznan and Prague show many analogies with Cracow.

The zone of weakness where Romanist and Orthodox clashed was exploited by Islam which for a while in the sixteenth and again in the seventeenth century held the mid-Danubian loess and threatened Vienna. The Polish Romanists in the seventeenth century effected a religious compromise whereby many Ukrainians acknowledged the Pope, but retained their Slavonic (Orthodox) ritual and the custom of married parish priests, often, at the same time, millers or timber merchants. Pressure on these "Uniates" from the Roman side in the period 1920–30 contributed to acceptance by the Polish Ukraine of Russian rule after the second World War.

Attempts at a green revolution whereby the peasantries of the European loess would have become small owners were not very successful in modernizing old-time methods and an impartial estimate just before 1940 made it clear that many peasants on minutely subdivided fields were underemployed and underproductive.[10] Their subsequent fate has so far been tragic.

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[7] A. Nehring in W. Koppers (ed.), *Die Indo-germanen- und Germanen-Frago*, Vienna, 1936, especially pp. 146–8.

[8] Herodotus, *Histories, Book IV, Melpomene.*

[9] E. Gibbon, *Decline and Fall of the Roman Empire*, vol. 3, ch. 34, p. 437, Methuen's Standard Library edition, London, 1905.

[10] *Documentation* for the European Conference on Rural Life 1939, Rome, International Institute of Agriculture, 1939.

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